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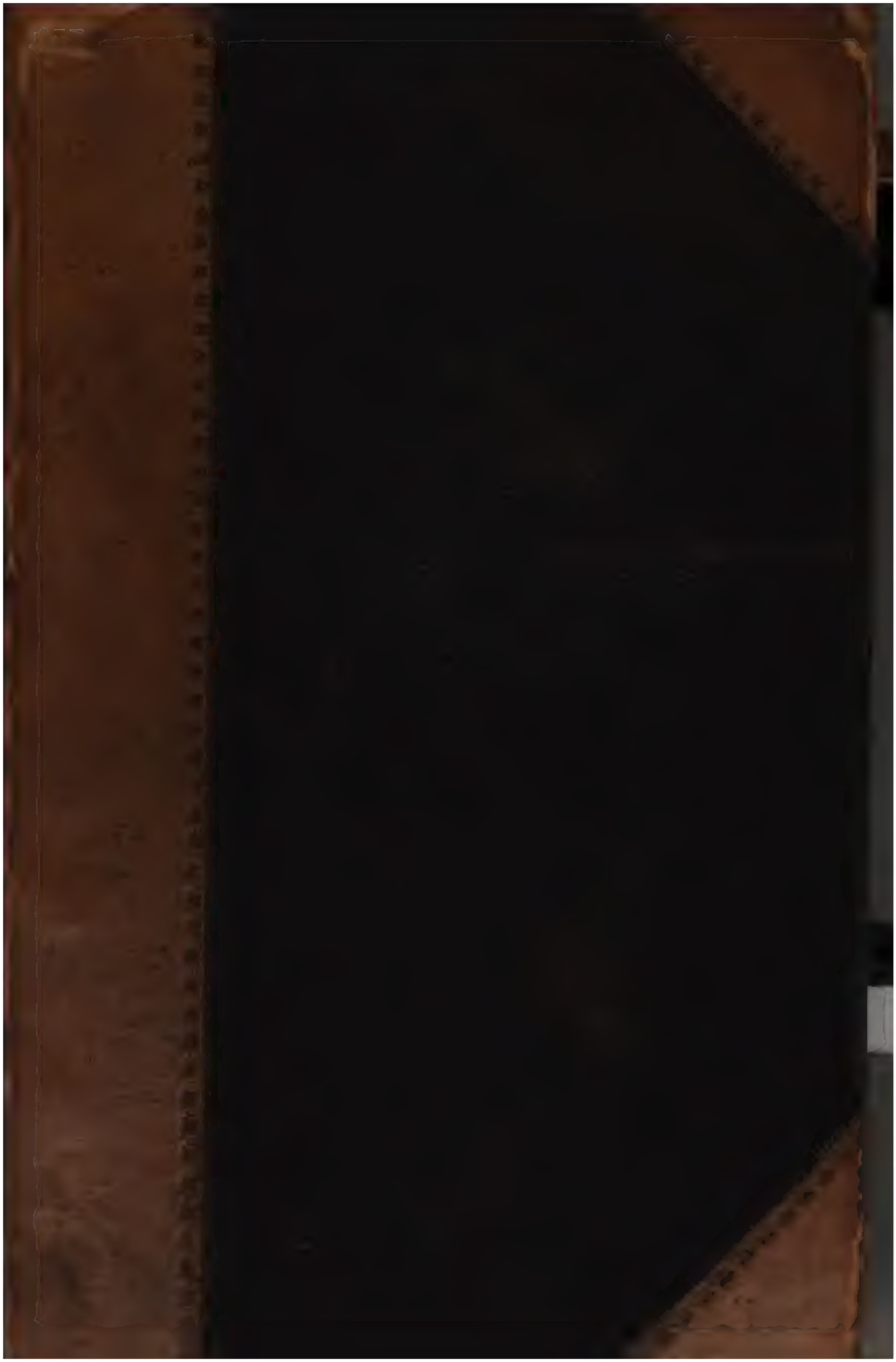
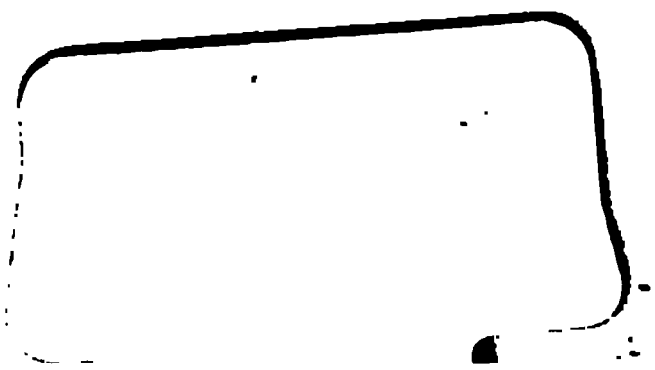




ILLUSTRATIONS OF DISSECTIONS

OF THE

HUMAN BODY.

[For the Illustrations
see Folios, Cam Radel.]

ILLUSTRATIONS OF DISSECTIONS

IN A

SERIES OF ORIGINAL COLOURED PLATES,

THE SIZE OF LIFE,

REPRESENTING THE

DISSECTION OF THE HUMAN BODY.

BY

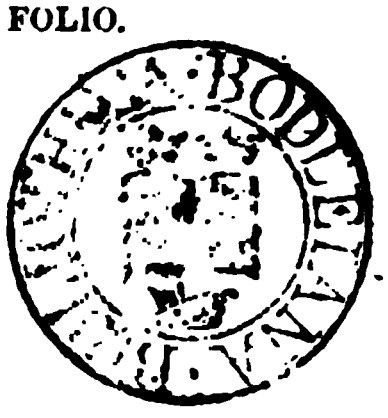
GEORGE VINER ELLIS,

PROFESSOR OF ANATOMY IN UNIVERSITY COLLEGE, LONDON;

AND

G. H. FORD, Esq.

THE DRAWINGS ARE FROM NATURE AND ON STONE BY MR. FORD, FROM DISSECTIONS BY PROFESSOR ELLIS, AND FORM A SEPARATE VOLUME IN IMPERIAL FOLIO.



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PREFACE.

THESE Anatomical Plates exemplify the method of dissecting practised in University College, London; and they are designed to serve both as patterns for the Student to copy in his dissections, and as aids to him in after-study.

For the purpose of carrying out the pictorial representation of dissections the part of the human Body to be illustrated is divided into suitable stages or regions; and the muscles, bloodvessels, and nerves of each region are shown in layers in the natural order of succession, so that their mutual connections may be brought before the eye at one and the same time.

The Illustrations comprise views of the Head and Neck, the upper Limb, the Perinæum, the Abdominal parietes, the Pelvis, and the lower Limb; and they are accompanied by a concise description of the objects displayed in each Plate, with a short notice of the practical applications of Anatomical facts to Surgery. All the Figures are drawn of life-size from actual dissections; and they are printed in colours with the object of making them as true pictures as possible of Nature, and more serviceable as copies for the Student to imitate. Only such dissections were prepared for the Drawings as may be commonly seen in the practical Anatomy Room; and the minute detail, whose counterpart the Student with average manual dexterity could not produce without some difficulty and loss of time, was inten-

tionally omitted. Delineations of the ligaments, the viscera of the cavities of the Body, and the organs of the Senses, are not included in the Plates now published.

The labour connected with this Work was divided between its two authors, that part being apportioned to each which he was best fitted by previous knowledge and experience to execute. To Mr. Ford were assigned the original Drawings, and the chromo-lithography; and to him is due the merit of portraying with so much effect and exactness the natural appearance of the parts dissected. Upon me rests the responsibility of the selection of the Illustrations, the fidelity of the dissections, and the accuracy of the whole.

During the progress of this undertaking, which has been continued through several years, other engagements have necessitated my having recourse occasionally to the senior Students of the College for the help of their hands. To those Students, and to Mr. Samuel Onley in particular, I gladly offer my thanks for their assistance. And to Mr. J. S. Cluff, Demonstrator of Anatomy, I am greatly indebted for the valuable aid he has afforded me at all times.

Before closing this retrospect of the task now finished, I may advert to the difficulties attendant on the printing in colours of such complicated Figures, and to the successful way in which they have been overcome by Mr. West.

GEORGE VINER ELLIS.

UNIV. COLL. LOND.,
September 1*st*, 1867.

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CORRIGENDA.

Page 196. Sixth line of the Table : *for* obliquus oculi inferior, *read* obliquus capitis inferior.

,, 196. Seventh line of the Table : *for* obliquus oculi superior, *read* obliquus capitis superior.

,, 197. Tenth line of the Table : *for* internal mammary artery, *read* internal maxillary artery.

,, 288. Line twenty-eighth : *for* Plates XLI. and XLII., *read* Plates XLII. and XLIII.

ILLUSTRATIONS OF DISSECTIONS.

DESCRIPTION OF THE PLATES.

DESCRIPTION OF PLATE I.

THE superficial muscles of the thorax, and the axilla with its contents, are delineated in this Plate. The natural size of the dissected part has been slightly reduced in the drawing for the purpose of showing the whole of the upper limb.

In the preparation of the dissection the limb was drawn away from the trunk to render tense the muscles. Next the integuments were divided, and the skin was raised in one large flap from the front of the thorax and the axilla. Then, the cutaneous nerves being found, the pectoral muscle was cleaned by carrying the scalpel upwards and outwards from the chest to the arm, as the fibres of the muscle run, and along one muscular fasciculus at a time. Afterwards the fat was cleared out of the axilla; and the muscles bounding the space behind were laid bare in the same way as those limiting it in front.

MUSCLES OF THE THORAX AND ARM.

Two sets of muscles are displayed in the dissection; one bounding the arm-pit before and behind; and the other lying in front and at the back of the humerus.

The former group are directed from the trunk to the limb, and move the limb forwards and backwards over the chest. Where they are fixed to the thorax they are separated widely by the ribs, but

at the arm bone they approach one another. In the interval between them near the humerus, the large vessels and nerves of the limb are lodged.

The muscles of the arm connect the limb with the scapula and assist in the movements of the shoulder joint : they will be more fully seen in other dissections.

A. Pectoralis major.
B. Pectoralis minor.
C. Latissimus dorsi.
D. Teres major.
F. Serratus magnus.
H. Subscapularis.
K. Coraco-brachialis.
L. Biceps.
M. Fascia of the arm.
N. Triceps muscle.
P. External head of the triceps.

The *pectoralis major*, A, reaches from the chest to the arm over the front of the axilla. By its inner end (origin) it is attached to the sternum and the cartilages of the true ribs, except the last, as well as to a part of the clavicle ; and it joins the tendon of the external oblique muscle of the abdomen below. By its outer end (insertion) it is fixed into the bicipital groove of the humerus. Plate ii. P.

The muscle forms the main part of the anterior boundary of the axilla, and towards its lower end near the arm-pit the mamma or breast rests on it.

Should the breast be diseased so as to render necessary its removal, the limb should be placed during the operation in the position shown in the drawing, and the scalpel should be carried in the direction of the fibres in detaching the mass to be extirpated.

The *pectoralis minor*, B, is extended like the preceding from the chest to the limb in front of the axilla. Only a very small part is now visible : for a view of the muscle see Plate ii. B.

The *latissimus dorsi*, C, resembles in its position behind the axilla the large pectoral muscle in front. Arising below from the spinal column, the pelvis, and the lower ribs, it is inserted into the bicipital groove of the humerus. The upper edge of the muscle has been everted in the drawing to bring into sight the vessels and the nerve lying within its edge.

Oftentimes a fleshy slip is continued over the axillary vessels

from the latissimus to join the pectoralis major, the fascia of the arm, or the coraco-brachialis muscle.

The *teres major*, D, lies behind the latissimus, by which it is partly concealed. Attached below to the scapula, it is inserted into the humerus beneath the broad muscle of the back, C.

The three muscles, pectoralis major, latissimus, and teres, converging from the trunk and scapula to the upper part of the arm-bone, will approximate the raised moveable limb to the trunk when they act simultaneously; and the limb will be moved forwards or backwards in accordance with the preponderating action of the pectoral or of the two others. Their action may occasion dislocation of the humerus under the following circumstances: in falling, with the arm outstretched, the elbow comes into contact with the ground, and renders the lower end of the humerus immoveable; and if the muscles then act suddenly and forcibly they will draw down the upper end of the bone which is free to move, and bring it into the axilla.

The *serratus magnus*, F, shuts out the ribs from the axilla, as it is directed backwards from the chest to the scapula. Its separate slips of origin from the ribs (serrations) are marked by the passage between them of nerves, and here and there of small vessels.

The *subscapularis*, H, fills the hollow of the scapula and excludes this bone from the axilla. The upward and outward direction of its fibres over the shoulder joint is indicated in the drawing. For a description of the muscle, see the explanation of Plate ii.

The arm muscles are the coraco-brachialis, K, and biceps, L, in front of the humerus, and the triceps, N, behind that bone. The share taken by the two last muscles in the outline of the limb may be seen in the drawing: their anatomy will be studied in other dissections.

The *coraco-brachialis*, K, attached as the name expresses, is displayed fully in Plate ii. As here seen, it is partly subcutaneous, and lies partly beneath the pectoralis major. The swell of the muscle is felt readily through the teguments, and serves as the surgeon's guide to the axillary artery along its inner edge.

THE AXILLA.

The axilla corresponds with the surface depression of the arm-pit. As it is a portion of the space included by the thoracic muscles converging to the humerus, it has necessarily a pyramidal form ; and it is limited in front and behind chiefly by those muscles, whilst inside it is the chest and on the outside the humerus. This intermuscular interval lodges the large vessels and nerves of the limb, with lymphatics, and contains a loose granular fat.

Along the fore part lies the pectoralis major, A, reaching from apex to base, and forming by its lower or free edge the anterior fold of the arm-pit; and underneath it, constructing only a small part of this boundary, is the pectoralis minor, B. After the fat had been removed from the space, the pectoralis sank down somewhat, as the drawing indicates, in consequence of the body not being very fresh.

Bounding the interval behind are three muscles, viz., the subscapularis, H, the latissimus, C, and the teres major, D : the two latter muscles enter into the formation of the lower part of this boundary, and extend lower down the limb than the pectoralis. Within the edge of the latissimus, here shown everted, is a hollow containing vessels, nerves, and glands, in which pus may burrow, or slightly enlarged glands may lie undetected by the fingers.

On the inner convex side of the axilla is the serratus magnus, F, covering the four highest ribs and their intercostal muscles.

On the outer side, where the space is limited, are placed the humerus and the contiguous part of the scapula, with the coracobrachialis, K, and biceps, L, muscles.

The base, or the elongated lower opening of the axilla, is wider at the chest than at the arm ; but it is not so wide before as after the dissection, because the parts when cleaned separate from each other. A rather dense fascia closes the axillary space in this direction, and impedes the advance of pus to the surface.

The apex or narrowed part of the space joins the root of the

neck, and lies between the chest and the scapular arch. It cannot be recognised in this drawing, but it may be observed more completely in Plate ii.

The state of the muscular boundaries of the axilla is much altered by the position of the limb,—the tenseness being diminished when the arm is adducted, and increased when the arm is abducted from the thorax; and the depth will vary, in like manner, with change in the position of the arm. These facts may be remembered with advantage in any endeavour to estimate the size of a tumour in the axilla.

In consequence of the position of this intermuscular space at the inner side of the shoulder bone, and of the loose nature of the fatty tissue contained in it, the movements of the scapula over the chest are unimpeded. And from its situation on that side of the shoulder joint to which flexion is made, the large vessels and nerves of the limb are transmitted through it beyond the joint without injury from stretching in the motions of that articulation. A corresponding hollow exists in the lower limb in front of the hip joint.

In the undissected limb the student may recognise by the eye and the touch the prominence of the cords of the large axillary nerves and vessels along the side of the arm; and if the arm is raised and freely moved by one hand, whilst the two fore fingers of the other are pressed into the arm-pit, the moving head of the humerus may be felt through the skin and fascia. During life the hollow is useful to the surgeon in his attempts to discover the nature and size of an enlargement, such as an aneurism, in this situation, or the position of the dislocated head of the humerus. But the size of the space interferes with the detection of small tumours like an enlarged gland, as these may extend upwards and inwards towards the chest in the loose fat, and acquire considerable size before their presence will be indicated by any external swelling.

ARTERIES OF THE AXILLA.

The lower end of the axillary artery with its branches are now brought under notice; but only a small narrow strip of the arterial trunk can be seen in the drawing in consequence of its connections with veins and nerves being preserved. This part of the vessel is uncovered by muscle, and is in contact with the common investing parts of the limb. A superficial wound of the limb may lay it open. It supplies branches to the chest and the shoulder.

a. Axillary artery.
b. Long thoracic.
d. Alar thoracic.
e. External mammary.
f. Subscapular.
g. Dorsal scapular.
h. Posterior circumflex.
n. Cutaneous artery with the internal cutaneous of the musculo-spiral nerve.
o. Artery to the long head of the triceps muscle.

The *axillary* or main artery of the upper limb crosses the space from the chest to the arm beneath the pectoral muscles, but only the part between the lower border of the pectoralis major, A, and the lower border of the teres major, D, is delineated. Its position is marked by the swell of the coraco-brachialis muscle, K; and its depth from the surface is very slight, only the tegumentary coverings of the limb concealing it, so that it can be readily reached, or it can be compressed with ease against the humerus.

Its connections with the muscles around are the following:—Behind are the subscapularis, H, the latissimus, C, and teres major, D; and on the outer side is the coraco-brachialis, K.

Its companion vein (axillary) is placed on the inner or chest side, partly concealing the artery, and has to be drawn aside in attempts to tie the axillary artery.

Large nervous trunks lie around the artery:—outside is the median nerve, 22; inside the ulnar, 21, and the nerve of Wrisberg, 11 (which is sometimes nearer the artery). Superficial to the vessel is the large internal cutaneous, 18, and deeper than it or beneath, is the musculo-spiral, 13 (which is drawn

somewhat inwards below); another nerve beneath the artery for a short distance is the circumflex, 12.

Two named branches, the subscapular, *f*, and the posterior circumflex, *h*, leave this part of the artery opposite the edge of the subscapularis muscle.

Ligature of the vessel.—The origin of several branches from the axillary artery opposite the shoulder joint, would interfere with the application of a ligature at that spot; but for a distance of two inches beyond (towards the arm) the vessel is free from any large branch, and might be tied without risk of hæmorrhage.

Suitable as the lower part of the axillary trunk seems to be for an operation at this place, surgeons have not chosen it for the application of a ligature. Doubtless the advantages offered by tying the brachial and subclavian arteries have caused those vessels to be selected in preference to the axillary; but the small channels that remain for the collateral circulation after the main artery is secured may have had some influence in inducing surgeons to let the operation on this part of the axillary artery remain unpractised. For the only collateral vessels to carry on the circulation after the occlusion of the trunk would be the small and indirect anastomoses through the following muscles, viz., the coraco-brachialis, biceps, and long head of the triceps; and through the shaft of the humerus.

Although the collateral vessels are so small and indirect, they are sufficient for carrying on the circulation, as the artery has been tied with success in this situation. M. Blandin secured the vessel here in a man who had an injury of the artery by a gunshot wound. The man recovered.*

Should the surgeon be called upon to tie the artery he should keep in mind its situation along the edge of the coraco-brachialis, with its companion vein on the thoracic side and partly concealing it, and with large nerves of the brachial plexus around it. Though the vessel is usually very superficial, it may be placed under muscular fibres directed over it from the latissimus to the pectoralis.

* Traité d'Anatomie topographique, p. 506 : Paris, 1834.

Two other points deserve attention also: Firstly, that two arteries instead of one may be found as often as 1 in 10.* Secondly, that not unfrequently the nerves, which should serve as the deep guide to the artery, are not placed around the parent trunk, but encircle a large branch formed by the conjunction of the usual offsets at this spot with some of the branches derived, as a rule, from the brachial artery.

When practising on the dead body the tying of the part of the artery issuing from the axilla the following directions may be observed :—

The limb is to be placed at right angles to the trunk, and the operator stands between the two.

With the eye fixed on the prominence of the coraco-brachialis muscle, K, which is the superficial guide to the vessel, a cut is to be begun in the hollow of the arm-pit, and to be continued along the side of the muscle for two inches; but the knife is not to be carried deeper at first than through the skin and fat.

The axillary vein will now be recognised through the deep fascia or aponeurosis of the limb by its blue colour; and the aponeurosis being divided along the outer edge of the vein as far as the cut in the integuments, this vessel may be detached with care from the subjacent parts, and drawn inwards with a narrow retractor.

Next the brachial plexus around the artery will serve as the deep guide. Search is to be made for the axillary trunk by cutting a piece of fat from the hollow out of which the vein has been drawn, and it is to be made in a horizontal direction or towards the humerus, instead of backwards towards the axillary fold. The operator tries to find the artery in the midst of the nerves without attempting to distinguish the individual nerves.

After the thin arterial sheath has been opened by the knife, the needle may be passed readily, and the vessel is to be tied with as little displacement as possible.

When the artery is not surrounded by the nerves of the brachial

* The facts on which this statement rests will be found in the Surgical Anatomy of the Arteries of the Human Body, by Richard Quain, F.R.S.: London, 1844.

plexus, as referred to above, it will be nearer the vein and the surface than it is usually.

In the treatment of aneurism of the lower end of the axillary trunk Professor Syme has recently recommended a return to the old practice of opening the sac, and after removing the contents, putting a thread around the vessel above and below the sac. In a postscript to a communication published in the Medico-Chirurgical Transactions * he says :—"On the 15th of August, in accordance with the principles above explained, I performed the old operation for aneurism, not traumatic, at the lower part of the axilla, in a gentleman about fifty, recommended to my care by Dr. Embleton, of Embleton in Northumberland. The patient returned home on the 5th of September."

Branches of the artery.—The lower part of the axillary artery supplies the following branches to the wall of the chest and the shoulder.

Long thoracic artery, b, lies in the axilla along the angle formed by the meeting of the anterior and inner boundaries, and may be injured by cuts made along the anterior axillary fold. Its origin is concealed by the pectoralis major.

Alar thoracic branch, d. This small artery to the arm-pit was present in this body, though it is generally absent (Quain). It is distributed to some of the glands, and to the fat of the axilla.

The *subscapular artery, f*, is the largest offset, and arises opposite the edge of the subscapularis muscle. Taking the edge of the muscle as its guide, it reaches the chest, to which and the shoulder it is distributed. A companion vein and nerve run with it, and all are secured from external injury by the projecting edge of the latissimus dorsi. Many offsets enter glands and the contiguous muscles; and one, *g*, larger than the rest, is the dorsal scapular artery.

The *posterior circumflex artery, h*, arises close beyond the preceding, and winds behind the humerus to the shoulder with the nerve, 12, of the same name. Its distribution is represented in Plate v.

* On the Treatment of Axillary Aneurism, by James Syme, F.R.S. Edin., vol. 43, p. 143 : London, 1860.

An anterior circumflex artery, not now visible, crosses over the humerus but under the coraco-brachialis to the shoulder.

The *external mammary*, *e*, is a long slender irregular branch, which is directed across the axilla to the chest, lying about midway between the anterior and posterior folds. It supplies the glands and the wall of the chest, assisting the long thoracic artery.

Muscular and cutaneous branches.—Small offsets near the end of the artery supply the coraco-brachialis, K., and the long head of the triceps, N. And a cutaneous twig, *n*, accompanies the internal cutaneous branch of the musculo-spiral nerve.

An inspection of the drawing will suffice for showing the vessels or nerves likely to be injured in wounds into the axilla, or in incisions made into it by the surgeon. Along the anterior boundary, where this joins the chest, are placed the long thoracic vessels; and lying along the posterior boundary, but within the margin of the latissimus, are the subscapular vessels and nerves with glands. On the side of the limb, or at the outer part, the trunks of the axillary vessels and nerves, and the cords of the brachial plexus are aggregated together; whilst on the side of the chest there is only an occasional small artery. If an incision is then to be made into the arm-pit the surgeon should select the inner boundary as the freest from vessels, and should direct the knife about midway between the anterior and posterior folds.

VEINS OF THE AXILLA.

Only the position of the chief vein to the artery was aimed at in the dissection, and the smaller veins, which would complicate the drawing without corresponding utility, were therefore removed.

l. Axillary vein.
m. Subscapular vein.
p. External mammary vein.
r. Cutaneous and muscular vein.

The *axillary vein*, *l*, the chief vein of the limb, is continuous in the arm, just beyond the axilla, with the cutaneous vein, basilic. Placed on the inner or thoracic side of, and partly concealing the axillary artery, it receives small contributing veins, corresponding with the arterial branches. Some of these are seen in the drawing.

Frequently two veins instead of one are found in the lower part of the axillary space.

Through this vein nearly the whole of the blood of the limb below the shoulder is conveyed to the trunk, and interruption to its current will occasion congestion in the parts to which its roots extend. A tolerably complete occlusion of this main circulating channel, as in the case of a slowly-growing tumour, will not only give rise to congestion, but will cause serous fluid to transude through the coats of the vessels into the surrounding structures.

NERVES OF THE AXILLA.

The nerves in this dissection are derived from two sources :— Those on the side of the chest are offsets of the intercostal nerves, and appear between the digitations of the serratus magnus muscle ; and those lying around or near the axillary vessels belong to the brachial plexus.

Lateral Cutaneous of the Thorax.

1. Lateral cutaneous branch of the second intercostal nerve (the highest of the set).
2. Offset of third intercostal.
3. Offset of fourth intercostal.
4. Offset of fifth intercostal.
5. Offset of sixth intercostal.
6. Anterior branch of the offset of the second intercostal.

* * * Anterior branches of the offsets of the other intercostal nerves.

7. Communicating branch to the nerve of Wrisberg from the offset of the second intercostal nerve.

Brachial Plexus.

8. Nerve to the teres muscle.
9. Subscapular nerve.
10. Nerve to the serratus magnus.
11. Nerve of Wrisberg.
12. Circumflex nerve.
13. Musculo-spiral.
14. Offset of the musculo-spiral to the triceps.
16. Internal cutaneous of the musculo-spiral.
18. Large internal cutaneous.
20. Offset of the internal cutaneous to the integuments.
21. Ulnar nerve.
22. Median nerve.

NERVES OF THE BRACHIAL PLEXUS.

The *median*, 22, is the companion nerve to the artery, and placed on the outer side, is without branches in this part.

The *ulnar nerve*, 21, smaller than the median, but like it without branch, lies to the inner side of the vessel.

The *musculo-spiral*, 13, occupies naturally a position beneath the vessel, but it has been pulled inwards, and is represented in the Plate as on the inner side. Here it furnishes two small branches: one muscular, 14, to the inner and middle heads of the triceps; the other is the internal cutaneous, 16, which is distributed to the integuments of the back of the arm.

The *circumflex nerve*, 12, accompanies the artery of the same name, *h*, to the deltoid muscle. See Plate v.

Large internal cutaneous nerve, 18, lies on the axillary artery, and gives a small cutaneous offset, 20, to the integuments of the arm over the situation of the blood vessels; but its direction has been altered by the displacement of the skin.

Small internal cutaneous nerve, 11, (nerve of Wrisberg) issues beneath, though sometimes through the axillary vein, and is joined by a branch, 7, from the highest lateral cutaneous nerve of the thorax. Its position close to the vein has been disturbed by the dragging of the skin.

Muscular branches.—The nerve to the teres major, 8, and the nerve to the latissimus, 9, are directed with the subscapular vessels along the back of the arm-pit to their destination; the former gives an offset to the subscapularis muscle.

The nerve to the serratus magnus is continued on the surface nearly to the lower border of its muscle, giving backwards offsets to the fleshy fibres. Its origin is connected with the trunks of the fifth and sixth cervical nerves in the neck.

Pressure applied to the nerves of the brachial plexus may occasion pain, or loss of power and feeling, according to its degree, in a greater or smaller part of the limb. In the use of crutches the weight of the body acts injuriously on the nerves, for the arm is arched over the top of the crutch, and the nerves are compressed between the humerus and the artificial prop of the body. This inconvenience will be remedied by the crutch-head being so constructed as to bear least on the centre of the arm over the position of the large nerves.

LATERAL CUTANEOUS NERVES OF THE THORAX.

Five of these offsets of the intercostal trunks were laid bare in the dissection; they appear lax after they have been detached from the surrounding fat. The branches directed forwards over the pectoralis were necessarily detached from the skin, and were then laid on the surface of the muscle.

As the first intercostal trunk does not furnish commonly any lateral cutaneous branch, the nerves shown are derived from the five next intercostal trunks. Each nerve divides into two parts (anterior and posterior) as it issues between the ribs, which end in the integuments of the lateral part of the thorax.

The anterior offsets, 6, * * *, end in the integuments covering the pectoralis major; and the posterior, 1, 2, 3, 4, 5, somewhat larger in size, ramify in the skin of the arm and in that over the latissimus dorsi. In this body the third nerve wanted an anterior offset.

The highest and largest of the lateral cutaneous nerves,—that from the second intercostal trunk, differs in some respects from the others. Its anterior branch, 6 (laid on the pectoralis, and not always present), supplies the arm-pit as well as the coverings of the pectoralis major: its posterior branch, 1, called intercosto-humeral, reaches the integuments of the back of the arm, and gives a communicating offset, 7, to the nerve of Wrisberg.

LYMPHATICS OF THE AXILLA.

Only a few of the glands of the axilla were retained in the dissection, and these have fallen necessarily from their natural position after the removal of the fat in which they are imbedded.

† † † Anterior group of the axillary glands.
s s s. Posterior group of glands.
t. One of the group of glands along the side of the axillary vessels.

About ten or twelve in number, the glands vary much in their shape and size. They have the following general linear arrangement in sets. The greater or hinder group lies along the sub-

scapular vessels within the edge of the latissimus dorsi ; but after the dissection of the axilla they hang in front of the muscle by their small vessels, as is shown in the drawing. Another or anterior group is nearer the fore part of the axilla, in connection with the long thoracic and external mammary arteries. And a third set is placed along the large axillary vessels.

Each collection of glands has for the most part its own set of lymphatic vessels. Thus the anterior group receives lymphatics from the fore part of the thorax and from the mamma: the posterior group is joined by the lymphatics from the side and from the back; and that along the bloodvessels transmits lymphatics from the upper limb. The lymphatic vessels, after passing through their respective glands, unite into one or more trunks at the top of the axilla, and open into the lymphatic duct of the same side.

Disease in the part from which the lymphatic vessels are derived may occasion enlargement of the group of glands through which those vessels are transmitted ; and the knowledge of the destination of the lymphatics will suggest the glandular group likely to be affected :—Thus, a poisoned wound of the hand, as in dissection, will cause inflammation of the glands by the side of the axillary vessels ; and so forth.

In making the necessary examination to detect disease of the glands, the limb should be approximated to the side to relax the muscles and fascia bounding the axilla, and thus to permit easier and freer manipulation. The glands near the axillary vessels follow the arm when this is elevated.

Enlargement of a gland may surround or press upon the intercosto-humeral nerve, or the nerve of Wrisberg, and occasion numbness in the part to which either nerve is distributed.

Should extirpation of a diseased gland be considered advisable, the surgeon should be mindful that it has large bloodvessels, in the form of a foot-stalk, which are derived from the contiguous vessels ; and he should secure the vascular pedicle with a thread before he cuts it through. If this precaution is neglected the divided vessels retract into the loose areolar tissue of the axilla, and may continue to bleed at intervals so as to endanger life.

FAT IN THE AXILLA.

The axilla is filled with a granular fat intermixed with slight areolar tissue. Towards the apex of the space the adipose tissue diminishes. In thin bodies the quantity of the fat is less, as it is in all other parts, and the space contains a watery fluid in the meshes of the areolar tissue.

The presence of fat favours in this space, as elsewhere, the accumulation of pus, which burrows amongst the loose fatty material instead of making its way to the surface through the intervening fascia. Much inconvenience and suffering may be avoided by an early incision for the escape of the confined pus.

DESCRIPTION OF PLATE II.

THE drawing represents the deep dissection of the front of the chest, and that of the axillary vessels and the brachial plexus of nerves with their branches.

The dissection is to be made by cutting through and reflecting the pectoralis major. To render tense and distinct the sheath of the axillary vessels, place the limb at right angles to the trunk, and rotating it inwards, press it backwards, so as to raise the clavicle from the chest. Unless this position of the arm is kept, the loose costo-coracoid sheath may be removed with the fat.

SUPERFICIAL PROMINENCES OF BONE.

At the upper part of the region dissected is the bony loop of the scapular arch, which is formed by the clavicle, J, and the scapula, and separates the neck from the chest and the limb. It serves the purpose of articulating the upper limb, and furnishes points of attachment to muscles moving the humerus. Injury of the arch, sufficient to break it, will arrest the free movements of the shoulder joint, and interfere with the action of the muscles.

Part of the arch is subcutaneous, and the fore finger when carried along it traces successively the outline of the clavicle, acromion, and spine of the scapula. From its slight depth injuries of it are easily ascertained, because all irregularity of the surface can be detected at once with the finger.

On the inner side of the shoulder joint below the clavicle, and projecting at the edge of the deltoid muscle, R, is the coracoid process. It gives attachment to the three muscles B, K, and L, as well as to a strong ligament (coraco-clavicular), which passes from its upper and hinder part to the under surface of the clavicle, uniting together firmly the two bones. On the surface this projecting point of bone can be felt between the deltoid and pectoral muscles.

In consequence of the clavicle acting as a prop to keep the shoulder from the trunk, it is very liable to be broken. By direct violence it may be shattered at any spot ; but force applied to the outer end through a fall or a blow produces fracture generally about the middle of the bone.

In fracture of the shaft, that is, internal to the line of the coracoid process and the strong ligaments joining this part to the clavicle, the scapula and shoulder joint, having lost their support, fall downwards and inwards towards the chest, forcing the outer past the inner fragment ; and the large muscles of the chest which are inserted into the humerus assist in bringing the shoulder into closer apposition with the thorax. The inner fragment, freed from the weight of the shoulder, remains in its natural position, though it appears more than usually prominent; and the muscles attached on opposite sides, viz., the great pectoral and sterno-mastoid, may act also as antagonists, and prevent its displacement.

If the fracture is opposite or external to the strong ligaments uniting the coracoid process with the clavicle, the scapula remains attached to the clavicle by that ligament, though not perfectly supported by it, and the shoulder falls but little towards the chest. In fracture external to the ligament, there is, however, considerable displacement of the bone, for the outer detached end being loose, and acted on by the trapezius muscle, is placed in

front of the other, taking even a position at a right angle to it.*

In replacing the external fragment of a broken shaft of the clavicle, this piece of the bone must be moved outwards indirectly by forcing the scapula outwards, and it is to be raised to the level of the inner fragment by lifting and supporting the elbow.

At the outer part of the dissection is the projection of the shoulder, which is produced by the upper end of the arm bone covered by the deltoid muscle, R. When the limb is pendent the swell of the muscle runs into that of the arch formed by the clavicle and acromion ; and when the limb is raised and lowered, the arm bone can be felt moving under the muscle.

In dislocation of the shoulder joint the upper end of the humerus separates from the deltoid, and a hollow then occupies the site of the prominence. This injury is accompanied necessarily by unnatural direction of the shaft of the arm bone forwards or backwards, and by a sharp projecting edge along the bony arch constructed by the clavicle and the acromion process.

MUSCLES OF THE THORAX AND ARM.

A. Pectoralis major.
B. Pectoralis minor.
C. Latissimus dorsi.
D. Teres major.
F. Serratus magnus.
H. Subscapularis.
J. Clavicle withthe cut attachment of the pectoralis major.
K. Coraco-brachialis.
L. Biceps, its short head.
O. Biceps, the long head.
N. Triceps extensor brachii.
P. Insertion of pectoralis major.
R. Deltoid muscle.
S. Subclavius muscle.
V. Costo-coracoid membrane.

The muscles of the chest and shoulder, which are partly displayed in the drawing, give to the scapula and the shoulder joint some of their varied movements.

The scapula has a gliding motion over the ribs, and it can be moved in opposite directions ; it is drawn forwards by the small pectoral, B, and serratus magnus muscle, F, which attach it to the chest.

The shoulder being a ball and socket joint is provided with

* A Treatise on Fractures in the Vicinity of Joints, by Robert William Smith, M.D. : Dublin, 1850 ; p. 210.

muscles on opposite sides, but only two are now evident, viz., the deltoid or great abductor, R, and the subscapularis or internal rotator, H.

In the group of thoracic muscles are included the pectoralis major and minor, the serratus magnus, the latissimus dorsi, and the subclavius.

Pectoralis major, A.—After the division of the muscle the parts underneath it can be observed. It covers the pectoralis minor on the chest, and the coraco-brachialis, K, and the biceps, L and O, in the arm. Near the clavicle the subclavius muscle, S, and the costo-coracoid membrane, V, are beneath the pectoralis. Above and below the pectoralis minor the axillary vessels and nerves are covered by the great pectoral muscle alone.

At its insertion the tendon is divided into two layers, with a hollow between, something like a sling. On the under layer, P, the lower chest fibres are received ; and in the other (seen only in part) the upper thoracic and the clavicular fibres terminate.

The *pectoralis minor*, B, is attached to the side of the chest, and to the third, fourth, and fifth ribs ; it is inserted externally into the coracoid process of the scapula, where it blends in a common tendon with the coraco-brachialis, K, and the short head of the biceps, L.

Between the chest and the shoulder the muscle forms part of the anterior boundary of the axilla, and lies over the axillary vessels and nerves ; and between it and the clavicle is a triangular interval—the sides being formed by that bone and the pectoralis minor, the base by the thorax, and the apex by the coracoid process—in which the upper part of the axillary artery may be tied. Its position to other vessels and nerves is so apparent as not to need farther reference.

The pectoralis minor assists the serratus, as before said, in drawing forwards the scapula. And it may act as a muscle of forced inspiration when the scapula is the fixed part.

Serratus magnus, F, covers the side of the chest, taking origin by nine fleshy slips from the eight upper ribs ; and it is inserted by the opposite border into the base of the scapula. Its special nerve, 5, lies on the surface, and distributes offsets to it.

From the direction of its fibres the inference may be drawn that the muscle is chiefly concerned in moving forwards the scapula over the ribs; and that, when the scapula is fixed, it will act on the ribs so as to draw them outwards, and increase the size of the chest. It supports, too, the lower end of the scapula whilst a weight is carried on the shoulder.

Latissimus dorsi, C. The oblique direction of this muscle behind the axilla, converging with the pectoralis major to the insertion into the humerus, is more fully seen in this than in the preceding dissection. The chief notice of this muscle is given with the explanation of Plate i.

Subclavius, S. This small muscle is contained in a sheath of the costo-coracoid membrane, of which a piece has been cut out near the inner end. Named from the position to the clavicle, its origin is from the first rib, and its insertion is fixed into the grooved under surface of the clavicle.

It can depress the clavicle or elevate the first rib, according as the one or the other bone may be in a state to be moved.

Some of the shoulder muscles come into view in this dissection :—they are the subscapularis, teres major, and deltoid.

The *subscapularis*, H, arises from the hollowed costal surface of the scapula; and its fibres are directed outwards and upwards over the shoulder joint to their insertion into the small tuberosity on the head of the humerus.

By its lower edge it projects much beyond the scapula, and touches the latissimus dorsi and teres major. The muscle supports internally the shoulder joint, of which it is one of the articular muscles.

When the arm is raised from its pendent position, the muscle assists in depressing the same: it rotates inwards the hanging limb.

This muscle is injured in the following dislocations of the humerus. When the bone is forced into the lower part of the axilla, either it will be covered by the subscapularis, or it may be driven through the muscular fibres, and, coming into contact with, press upon the mass of the axillary vessels and nerves. In the forward dislocation on the inner side of the cervix of the scapula, the head of the bone passes between the subscapularis

and the scapula, separating the fleshy fibres from the bone, and projects above the upper border of the muscle.*

Teres major, D. Only the general position of the muscle extending from the lower angle and border of the scapula to the humerus can be now seen. The muscle is described with Plate v., D.

The *deltoid muscle*, R, forms the prominence of the shoulder, and reaches from the scapular arch to the arm bone below the level of the axilla. Only the fore part of the muscle is here represented : its insertion and connections are seen in Plate v., N.

Three muscles of the arm, biceps, coraco-brachialis, and triceps, are laid bare in the dissection—the two former, which are superficial to the humerus, being much more apparent than the latter, which is behind that bone. The anatomy of the triceps will be given in the notice of Plate vi.

The *biceps* muscle consists above (origin) of two parts, long head and short head.

The short head, L, is fixed by a wide tendon to the coracoid process ; and the long tendinous head, O, narrow and rounded, passes along the groove in the humerus, and through the shoulder joint, to be attached to the top of the glenoid articular surface of the scapula.

Lower in the arm the muscle is shown in Plate iv.

Coraco-brachialis, K. It arises from the coracoid process of the scapula, and from the tendon of the short head of the biceps ; and it is inserted into the inner side of the shaft of the humerus about midway between the ends. Its upper extremity lies beneath the pectoralis major; its insertion is concealed by the brachial vessels; and the intermediate part (belly) is subcutaneous in the arm-pit, and serves as the guide to the axillary vessels. Through the fleshy fibres of the muscle the musculo-cutaneous nerve, 11, is transmitted.

* The student will find the state of the muscles in dislocations of the shoulder joint fully treated in the article, Abnormal Conditions of the Shoulder Joint, in the *Cyclopædia of Anatomy and Physiology*, by Robert Adams, Esq., 1849.

If the limb is in a state of abduction, it can be brought to the side of the chest by this muscle.

The *costo-coracoid* membrane, V, is a rather strong layer of fascia between the upper limb and the neck, and is placed there apparently for the purpose of protecting the large blood-vessels. Occupying the interval between the first rib and the coracoid process, it is fixed above to the clavicle before and behind the subclavius muscle which it incases. Below it blends with the special sheath (axillary) of the blood-vessels, giving to this additional strength, and it is continued onwards beneath the small pectoral muscle, where it gradually ceases.

The *axillary sheath* around the vessels and nerves coming from the neck to the upper limb, consists in part of a prolongation from the deep fascia of the neck, and in part of a stronger layer added from the costo-coracoid membrane. It resembles the crural sheath around the blood-vessels of the lower limb, and is funnel-shaped like that tube. In it are the axillary artery and vein, and the brachial plexus; and piercing the front are branches of those trunks, viz., the cephalic vein, *l*., the acromial thoracic artery, *c*, and anterior thoracic nerves, 2, 3. In a dissection of the axillary sheath the tube is to be opened in the manner shown in the drawing, to see the position to each other of the contained blood-vessels and the brachial plexus of nerves.

ARTERIES OF THE AXILLA.

The connections of the trunk of the axillary artery, and the distribution of most of its branches, can be studied in Plate ii.

a. Axillary artery.
b. Superior thoracic branch.
c. Acromial thoracic branch.
d. Long thoracic branch.
e. External mammary branch.
f. Subscapular branch.
g. Dorsal branch of the subscapular.

The *axillary artery*, *a*, crosses from the chest to the arm through the axilla, and is limited above by the lower border of the subclavius muscle, S., and below by the lower edge of the teres major, D. Without dissection, the situation of the vessel may be indicated by a line, on the surface of the body, from a point of

the clavicle somewhat on the sternal side of the middle of the bone, to the inner border of the coraco-brachialis muscle, K.

In a dissection carried no farther than the one from which the drawing is taken, the artery is divided into three parts by the pectoralis minor, B., viz., one part above, one beneath, and one beyond the muscle.

The upper or *first part* lies in the axillary sheath between, but deeper than its companion vein and nerves. Superficial to the sheath is the clavicular attachment of the great pectoral muscle; and underneath it is the side of the chest with the intercostal muscles of the first space, and the serratus magnus, F.

Crossing over the artery, are some small branches of the companion vein and nerves;—thus directed over it from the outer side is the cephalic vein, *l*, and an anterior thoracic nerve, 3; and passing under it is the nerve to the serratus, 5.

Second part.—Here the artery is covered by both pectoral muscles, large and small; but it is without muscular support behind in consequence of its position across the axilla.

The large axillary vein, *h*, has the same relative position to this as to the first part; whilst the brachial plexus, 1, dividing into pieces, is so arranged that one bundle lies outside, another inside, and a third behind the vessel.

The *third part*, twice as long as either of the others, is in contact for two thirds of its length with the pectoralis major, but thence to the ending it is covered only by the common tegumentary structures. It rests successively from above down on the subscapularis, H, the latissimus dorsi, C, and the teres major, D. To its outer side is the coraco-brachialis muscle, K.

The position of the companion vein remains the same as above; but the connections of the nerves are altered, for the brachial plexus has divided into its terminal branches, which are placed on opposite sides of the vessel. Outside are two nerves, the musculo-cutaneous, 11, reaching only a short distance; and the median, 12, which extends throughout. Inside is the ulnar nerve, 13 (here somewhat displaced); and more or less removed from the artery, is the small internal cutaneous nerve, 9. Superficial to the artery is the large internal cutaneous, 14; and beneath

it, but concealed by it, the circumflex and musculo-spiral nerves—the former reaching only to the edge of the subscapularis muscle.

Number and position of the arterial offsets.—Branches are distributed internally to the thorax, and externally to the shoulder and arm.

From the first part come two offsets, the highest thoracic, *b*, and acromial thoracic, *c*; the first is small and irregular in its size and position; and the latter, of large size, springs close to the edge of the pectoralis.

Only occasionally is there any named branch on the second part.

Four or five branches spring from the third part of the parent trunk. The first of these, long thoracic, *d*, is close to the border of the pectoralis minor. The next or subscapular branch arises opposite the lower border of the subscapularis muscle. Two circumflex arteries take origin near the last, but they are concealed by the trunks of the axillary vessels. The last-named branch given off is the small external mammary, *e*.

Ligature of the artery.—The axillary artery may be tied near the clavicle, as well as near the ending (p. 7).

Near the clavicle, or above the small pectoral muscle, the vessel lies deeply, and is reached only after cutting through the pectoralis major. Two offsets, superior and acromial thoracic, spring usually from this part of the artery, with the supra-scapular (a branch of the subclavian) sometimes, and they leave scarcely interval enough for the application of a ligature, especially if the first is large. The connections also of the artery with superficial vessels and nerves are so complicated (see Plate) as to render hazardous ligature of it at this spot.

The vessel might be tied in this situation for aneurism of the lower part of the arterial trunk, or for the arrest of hæmorrhage after an operation high up the arm, but the difficulties of the operation and the chances of recurring bleeding are so great as almost to deter a surgeon from having recourse to the operation.

Should a wound of the artery necessitate its ligature here, a practical knowledge of the anatomy will assist the operator in his attempts to secure the vessel.

With the arm outstretched, the position of the artery will be

marked by a line over the surface of the pectoralis major, which has been described already (p. 21).

The surface depressions on the sides of the clavicular attachment of the pectoralis major being taken as the limit of the incisions, the operator divides by a transverse cut near the clavicle the integuments and the thin platysma muscle, and afterwards the clavicular part of the pectoralis, looking for the cephalic vein at the outer edge of the muscle. When the thick fleshy fibres of the pectoral muscle are cut through, the subjacent fat with small veins, arteries, and nerves, ramifying in it, will appear. With much caution the surgeon finds his way amidst these dangers to the axillary sheath, V, which he opens to the necessary extent.

In the bottom of the wound the firm white brachial plexus of nerves will conduct now to the artery deeply placed between, and overlapped by the nerves and the axillary vein. The artery will be recognised by its pulsation, feel, and colour; and when it is detached from the contiguous parts, the operator is recommended to enter the aneurism needle between the vein and artery, so that the point of the instrument may be directed towards the nerves as it turns under the arterial trunk.

Aneurism of the upper part of the axillary artery is a formidable disease. It may be confined to the axilla, enlarging forwards and backwards where there is least resistance, or it may pass the bounds of that space, and project above the clavicle into the neck. As long as the disease is low on the vessel, and is confined to the axilla, ligature of the end of the subclavian artery has been resorted to in its treatment. But when it rises above the collar-bone, and the subclavian operation is rendered unsuitable or impracticable surgeons have sometimes had recourse to the extreme measure of amputating the limb at the shoulder-joint, as there "seemed to be no alternative," to use the words of Professor Syme.

In the last-mentioned class of cases, which are so embarrassing to treat, Professor Syme recommends, that the aneurism should be laid open, and the contents removed, as in the old plan of operating on blood-tumours. From the result of two cases treated successfully in this way, he hopes that "axillary aneurism not

amenable to ligature of the subclavian artery may be remedied by the old operation;" and he thinks that, even in cases where ligature of the subclavian is practicable, the plan recommended may be preferable.*

Branches of the artery.—All the branches are distributed between the chest and the shoulder, and maintain the circulation in the limb when the parent vessel is obliterated. The number of the named branches has been estimated differently by anatomists in consequence of their irregularity.

The *highest thoracic*, *b*, is the smallest branch, and ends on the top of the chest above the pectoralis minor.

The *acromial thoracic*, *c* (humeral thoracic, thoracic axis?), supplies three sets of offsets, viz., external or acromial, internal or thoracic, and middle or ascending. The outer set enter the deltoid muscle; the inner set are furnished to both pectoral muscles, a few twigs reaching the side of the chest; and the middle set course over the axillary sheath to the subclavius, and the pectoral and deltoid muscles.

The *long thoracic branch*, *d* (external mammary?), courses along the lower border of the small pectoral muscle to the fifth or sixth intercostal space, where it ends in the surrounding parts, and communicates with the intercostal arteries. In the female it supplies the breast.

The *subscapular*, *f*, a large branch, passes along the muscle of the same name to the angle of the scapula, and is distributed by large branches to the contiguous muscles, serratus and latissimus, anastomosing in the first with the intercostals.

Near its beginning the dorsal scapular branch, *g*, leaves it to supply the opposite surfaces of the scapula. See Plate v.

Two *circumflex arteries* encircle the humerus, meeting on the outer side. Plate v. may be looked to for a delineation of them.

Other *muscular offsets* (not marked by letters of reference) enter the coraco-brachialis muscle.

Two occasional offsets are noticed below, viz., the alar thoracic and external mammary.

* See a Paper, before referred to, on the Treatment of Aneurism, in the Medico-Chirurgical Transactions of London for 1860.

Alar thoracic.—This belongs to the glands in the axilla, and is seldom to be found as a distinct branch (Quain): offsets to the glands are generally supplied by the subscapular. Plate i. If the alar thoracic exists as a separate artery, it may spring from the second or the third part of the axillary trunk.

The *external mammary*, *e*, appears to be a compensating branch to the long thoracic, *d*, both supplying like parts. It begins near the termination of the axillary trunk, and is accompanied by a vein, *m*.

Anastomosis of the branches.—The blood finds its way from one part of the body to another through the communications of the smaller branches, though its flow in the main vessel is obstructed; and the anastomoses of the branches of the axillary artery with those of the neck and the chest, by which the collateral circulation would be established after ligature of the axillary artery, will be now considered.

On the chest the thoracic offsets of the upper thoracic, acromial thoracic, external mammary, and subscapular branches, anastomose with the intercostal and internal mammary arteries.

On the shoulder the branches of the axillary communicate with two branches of the subclavian trunk, viz., the posterior scapular and supra-scapular. Offsets of the subscapular artery distributed to both surfaces of the scapula join both the above-mentioned subclavian branches. The remaining anastomoses take place only with the supra-scapular, and in the following way:—through the deltoid muscle this artery communicates with offsets of the acromial thoracic, dorsal scapular, and posterior circumflex; and through the capsule of the shoulder-joint with the anterior and posterior circumflex.

VEINS IN THE AXILLA.

All the smaller arterial companion veins which would interfere with the view of the arteries and nerves, have been taken away.

h. Axillary vein.
k. Brachial vein.
l. Cephalic vein.
m. External mammary.

The *axillary vein*, *h*, has the same extent as the artery by

whose side it lies, and it is continuous in the limb with the superficial vein called basilic. Plate iii. Throughout its length it maintains the same position with regard to the artery, *i. e.* on the thoracic side; and it has similar connections with the parts around. Below the pectoralis minor the vein is often double, and above that muscle it has been found divided once (Morgagni).

Contributing small veins, corresponding with the branches of the artery, enter it at intervals; it receives besides near the lower border of the subscapularis muscle a trunk, *k*, formed by the brachial veins, and near the clavicle, the superficial vein of the arm—cephalic, *l*.

The *cephalic vein*, *l*, ascending over the shoulder between the pectoral and deltoid muscles, sinks through the fascia of the limb, and directed under the great pectoral, pierces the axillary sheath to reach its destination. Its position to the axillary artery has been specially described.

NERVES IN THE AXILLA.

With the exception of one lateral cutaneous nerve of the thorax, all the nerves here represented are derived from the brachial plexus.

1. Brachial plexus.
2. Thoracic offsets of the plexus.
5. Nerve to the serratus magnus.
6. Nerve to the latissimus.
8. Lateral cutaneous of the second intercostal.
9. Small internal cutaneous.
10. Nerve to the teres major.
11. Musculo-cutaneous nerve.
12. Median nerve.
13. Ulnar nerve.
14. Large internal cutaneous of the arm.

The *brachial plexus* of nerves, 1, furnishes offsets to the chest, shoulder, and arm. Placed on the outer side of the first part of the artery, it surrounds the second part with its large trunks, and terminates in branches for the arm, which lie around the third part of that vessel. The following are its offsets to muscles bounding the axilla.

Anterior thoracic nerves are two or three in number: two, 2, 3, come from the outer part, and one, 4, from the inner part of the

plexus: they supply the pectoral muscles; the small pectoral receives its offsets by the under surface from the nerve marked 4.

Nerve to the serratus magnus, 5, comes from the plexus above the clavicle, and may be seen ramifying in its muscle.

Nerve to the latissimus dorsi, 6, enters opposite the axilla the under surface of its muscle.

The *nerve to the teres major* and *subscapularis*, 10, belongs specially to the first muscle, giving only a small piece to the latter; for this (the subscapularis) is supplied higher up in the axilla by offsets of the plexus.

The remaining branches of the brachial plexus are continued to the upper limb, viz.

The *small internal cutaneous*, 9 (nerve of Wrisberg), communicates in the axilla with the second intercostal nerve, 8.

The *musculo-cutaneous*, 11, pierces the coraco-brachialis. The *median*, 12, the *ulnar*, 13, and the *large internal cutaneous*, 14, lie by the side of the axillary artery, and will be traced afterwards in the limb. The remaining two branches of the plexus, circumflex and musculo-spiral, are concealed by the great axillary vessels.

Remarks on the plexus.—A tumour in the axilla compressing any of the surrounding nerves may occasion pain or dulness of feeling, according to the degree of injury, in the part to which the nerve or nerves disturbed by it may be distributed.

In dislocation downwards of the humerus into the arm-pit, the head of the bone pressing on the nerves which lie along its inner side, occasions the pain or numbness in the limb.

In the flap amputation of the shoulder joint, the large vessels and nerves are cut last as the knife forms the flap on the inner side, and the nerves not contracting after division like the other structures, reach to the end of the flap, and may be involved in the cicatrix left after the wound is healed, if they are not cut shorter.

One *lateral cutaneous nerve* of the thorax, 8, has been left to show its connections with the nerve of Wrisberg, 9. Sending a communicating offset to this nerve in the axilla, it is continued onwards to the integument of the arm as the intercosto-humeral.

LYMPHATIC GLANDS IN THE AXILLA.

One of the highest of the group of lymphatic glands by the side of the axillary vessels is shown in position on the side of the chest. Two small lymphatic vessels ascend from it, and pierce the inner side of the axillary sheath to join the deep lymphatics of the neck.

DESCRIPTION OF PLATE III.

A DISSECTION of the superficial vessels and nerves in front of the bend of the elbow, which are concerned in the operation of blood-letting, is copied in this Plate.

For the dissection a longitudinal incision was carried over the middle of the joint, and was limited by a transverse cut at each end. On reflecting the two flaps of skin, the subcutaneous vessels and nerves are found in the fat. A piece of the deep fascia should be raised, as it is seen in the drawing, to show the position of the deep artery and nerve.

BICEPS MUSCLE AND THE FASCIA OF THE ARM.

The deep fascia of the limb deserves special attention, as it is the only protecting layer between the cutaneous veins and the main artery of the arm.

A. Biceps muscle.
B. Deep or special fascia of the arm.
C. Piece of the deep fascia reflected.
D. Inner intermuscular septum.
F. Projection of the inner condyle of the humerus.
H. Intermuscular space on the front of the forearm.

Biceps muscle, A.—At its lower end the muscle diminishes in size, and becoming tendinous, is fixed into the radius. Higher in the arm it gives rise to the well-known prominence, with a groove or hollow on each side lodging the superficial veins of the arm, viz., the basilic, *h*, on the inside, and the cephalic, *k*, on

the outside. The swell of the muscle serves as a guide to the brachial artery along the inner edge.

The *deep fascia*, or the aponeurosis of the limb, invests closely the arm, and is pierced here and there by the nerves and vessels of the integuments. Its component fibres take different directions, some being transverse, others oblique; and it is joined at spots by offsets from the tendons of the muscles. One such offset added to it from the tendon of the biceps in front of the bend of the elbow, gives it increased strength between the deep artery, *l*, and the superficial median basilic vein, *g*.

On each side of the arm is a thickened part, which is fixed to the humerus between the flexor and extensor muscles, and is called intermuscular septum; these processes are attached to the condyloid ridges of the bone; and the inner one, best developed, is marked by the letter D.

Near the bend of the elbow, where the piece of the fascia is reflected, the contiguity of the underlying brachial artery may be observed.

The fascia is prolonged over the muscles to the forearm; and appearing through it below the elbow is a well-marked yellow line, H, pointing to an intermuscular space which contains the radial vessels.

Straightening the elbow-joint increases, and bending the joint relaxes the tightness of the fascia. So the pain consequent on tension of the fascia from accumulation of blood or other fluid beneath it, or from swelling of the parts enclosed by it, may be relieved by placing the limb in a bent position.

SUPERFICIAL VEINS AT THE ELBOW.

Great irregularity prevails in the arrangement of the superficial veins in front of the elbow. The condition of them depicted in the Plate is not quite usual, though it is sufficiently regular for the purpose of describing their anatomy.

a. Median vein of the forearm.
b. Anterior ulnar veins.
c. Posterior ulnar veins.
d. Radial vein of the forearm.
f. Median cephalic vein.
g. Median basilic vein.
h. Basilic vein of the arm.
k. Cephalic vein of the arm.

The *median vein*, *a*, lies along the middle of the forearm, and divides near the bend of the elbow into two, viz., an outer, the median cephalic vein, *f*; and an inner, the median basilic vein, *g*, into which the other veins of the forearm open. At its ending the median communicates through the fascia with a deep vein.

Anterior and *posterior ulnar veins*, *b*, and *c*, gather the blood from the opposite surfaces of the inner half of the forearm, and both join the median basilic, *g*,—the anterior ulnar entering about the middle, and the posterior ulnar at the ending of that vein.

The *radial vein*, *d*, ramifies on the back, and the outer part of the forearm, and opens into the end of the median cephalic, *f*. Oftentimes this vein is very small; or it may be wanting.

The *median cephalic vein*, *f*, reaches from the point of splitting of the median, *a*, to the outer border of the limb, where it unites with the radial, *d*, and forms the large cephalic vein, *k*. It crosses the limb obliquely in the hollow between the prominent biceps and the external muscles of the forearm. Underneath it lies the large external cutaneous nerve, 3, and over it pass some offsets of the same nerve. Generally this vein is the smallest of the two pieces into which the median divides, and it is sometimes absent.

A moderately tight bandage round the limb just above the elbow, as in the operation of bleeding, does not stop the flow of blood in the median cephalic vein in a muscular arm in consequence of the projection of the biceps receiving the pressure of the band. But the current of blood in the vessel may be commanded by the thumb inserted into the hollow outside the biceps, and pressed downwards steadily.

The *median basilic vein*, *g*, is directed inwards from the median vein, *a*; and uniting with the posterior ulnar veins, *c*, gives rise to the basilic vein, *h*. Usually longer and larger than the median cephalic, it is commonly more transverse in its direction, and is firmly supported by the subjacent fascia and muscle. Joining it at intervals are small unnamed veins. The chief branches of the large internal cutaneous nerve, 1, lie under, and smaller offsets over the vein; but in this dissection the main part of the nerve was

superficial to the vein. In the line of the yellow space, H, under the fascia, the brachial artery, *l*, crosses underneath the median basilic vein, the two being separated only by the aponeurosis of the limb somewhat thickened by the prolongation from the tendon of the biceps.

This vein being well supported underneath, the current of blood in it can be readily arrested by the thumb or finger, or by a band round the arm above the elbow compressing the basilic vein.

The *basilic vein*, *h*, begins at the point of union of the median basilic, *g*, with the posterior ulnar veins, *c*. Ascending through the lower part of the arm in the groove or depression inside the biceps, it sinks under the fascia half way up the arm, and becomes the axillary vein.

The *cephalic vein* of the arm, *k*, formed, as before said, by the junction of the median cephalic, *f*, with the radial vein, *d*, continues on the outer side of the biceps as far as the shoulder, and ends in the axillary vein. See Plate ii., *l*.

Blood-letting is practised commonly in the veins in front of the elbow. Either the median basilic, *g*, or the median cephalic, *f*, is selected for venesection according to its size; and the median basilic is most frequently opened in consequence of its being the largest, and on account of the readiness with which it may be fixed and compressed against the firm supporting parts beneath. If the operation is to be performed for the first time, the following directions may assist the student.

A narrow band or fillet is to be tied around the arm from two to three inches above the elbow, to stop the flow of blood in the superficial veins. This band should not be tied too tightly, as moderate pressure will arrest the current of blood in the veins; and tightness of the constricting band will compress the brachial artery in thin persons, and prevent the free entrance of the blood into the limb below the elbow. After the bandage has been applied, attention should be given to the state of the arteries, and the pulse should be felt beating with the force and frequency of the other arm; for if the pressure acts on the main artery so as to diminish the current of blood in it, a full stream of blood will not be maintained through the opening made into the vein.

Supposing the median basilic vein, *g*, to be selected for venesection, the position of the brachial artery is to be ascertained by the pulsation, and the vein is not to be opened directly over the beating artery. When opening the vein, the operator stands on the inner side of the limb and grasps the forearm with his hand, placing the thumb in front, and using his left hand for the right arm, and the opposite; and he will therefore hold the lancet in the left hand when taking blood from the left arm. With slight pressure of the thumb the vein is now to be fixed, and if this step is omitted, the point of the lancet only punctures and pushes aside the full and freely moveable vein. The aperture is to be made close to the thumb, both the skin and the vein-wall being divided obliquely to the same extent; and it should be large enough to prevent the blood clotting, and closing it too soon. To give the necessary size (about a quarter of an inch) the lancet is first to be pushed forwards, and is next to be made cut its way to the surface, in order that the structures may be divided from within out; for if the point of the instrument is thrust in and drawn out, making only a punctured wound, a very small quantity of blood will flow through the opening before this is narrowed or stopped by coagulating blood. As the walls of the vein are approximated by the compression of the thumb, too deep an insertion of the lancet may cut through the vein, causing effusion of blood beneath with resulting obstruction to the issuing current; and it may be accompanied by puncture of the subjacent brachial artery.

The operator does not relinquish his hold of the arm and his control of the vein (for only a few drops of blood will escape till the thumb is removed) until he has had time to put his lancet away, and bring the receiving basin into the proper position. After instructing the person being bled not to move the arm with the view of trying to direct the jet of flowing blood, he takes his thumb off the vein, and allows the blood to issue in a full stream, though he still supports the limb in his hand. Leaving the control of the limb to the patient, as when a stick is grasped by the hand, will oftentimes cause the flow of blood to cease; for if an attempt is made by him to direct the current of

blood by altering the position of the arm, the opening in the vein may be closed by the skin being brought over it.

Should this displacement of the skin take place, the blood accumulates under it, forming a tumour called "thrombus," and compresses the vein.

When sufficient blood has been obtained the thumb is to be placed as before close below the bleeding opening, stopping thus the current of blood, and the bandage is to be loosened. A small compress of linen, made ready before the vein is opened, is to be placed on the wound, and is to be fixed in position by the fillet applied like a figure of 8 around the elbow whilst the limb is slightly bent. Slight pressure of the bandage, a half bent state of the elbow, and rest, are most conducive to the healing of the wound.

If the median cephalic, *f*, should be selected at any time for venesection in consequence of its greater size, the steps to be taken in the operation are the same as those above referred to, with the exception of the manner in which the current of blood in it is to be checked. Tying up the limb in the usual way will scarcely exert pressure enough upon the median cephalic in a muscular arm, because the vein sinks into the hollow on the side of the biceps. A more effectual compression may be obtained by sinking the thumb in the groove between the biceps and supinator longus muscles; or if a fillet is used, by inserting under it a small compress over the situation of the vein. In consequence of its position in a hollow, the vein may be rather more difficult to reach with the lancet, especially in a fat person.

From the position of the brachial artery under the median basilic vein puncture of it may take place in the operation of bleeding. This serious accident is occasioned by cutting the vein directly over the artery, and pushing the lancet into the artery after transfixing the vein. Injury of another artery may ensue under some circumstances; thus, one of the large arteries of the forearm (radial or ulnar) may arise higher in the arm than usual, and in passing the elbow for its destination, may lie superficially, — being placed generally under the aponeurosis of the limb, but sometimes in the fat, by the side of the

veins.* When it is contained in the integuments, its projection in a fat arm might be taken for the swell of a vein on an insufficient examination. The occasional existence of such a state of the arteries should lead to a careful examination of the front of the elbow before venesection, with the view of detecting pulsation not only in the brachial trunk, but also in any other unusually placed artery.

Injury of an artery in blood-letting would be manifested by the blood being redder than ordinary venous blood; by the fluid escaping in jerks; and by pressure on the vein below the opening not stopping the bleeding. Such an untoward accident should be met by placing a conical compress on the wound, and by applying a bandage firmly along the limb with the intention of preventing the escape of the blood, and its accumulation under the deep fascia.

As the aperture in the artery does not heal readily, like the wound in the skin and the vein for instance, a blood-tumour or aneurism usually follows. This tumour receives blood through the hole in the artery, and will be inclosed in a sac formed by the surrounding parts (false aneurism).

Or the wound in the back of the vein not healing, a permanent communication with the artery is established, through which the arterial blood is driven into the vein, producing distension, and a varicose condition of the superficial veins below the elbow. If the edges of the contiguous openings in the vessels unite without the intervention of any sac, so that the vein receives blood freely from the artery, the term aneurismal varix is applied to that condition of the parts. If, on the contrary, a sac or tumour is formed between the artery and vein, which communicates with both, and serves as a channel by which the arterial current can pass into the vein, the aneurism is called varicose.

For the treatment of a blood tumour or aneurism formed after bleeding, whether it opens only into the artery (traumatic false aneurism) or joins both the artery and the vein (varicose aneurism), an operation on the brachial artery will be needed if its

* Surgical Anatomy of the Arteries, by Professor Quain.

enlargement cannot be controlled by pressure. And the operation fitted for the cure of the disease would be that of opening the tumour, and applying a ligature above and below the wound in the artery. If the tumour is somewhat solidified by the deposition of laminated fibrin in it, ligature of the brachial artery in the middle third of the arm would be had recourse to by some surgeons. But the safer practice seems to consist in tying the vessel at the wounded part as a rule; and this treatment would be most suitable also for aneurism connected with a wound of the radial or the ulnar artery in consequence of its unusual origin and its superficial position in the fat in front of the elbow. Professor Syme advocates cutting down upon the tumour in aneurism from a wound of the brachial in front of the elbow. He says: "I have treated all the aneurisms at the bend of the arm, resulting from wound of the humeral artery through venesection, which have come under my care, amounting to ten in number, by opening the sac, and applying ligatures on both sides of the aperture." *

In the aneurismal varix equable pressure on the limb, which will check the arterial blood entering the tube of the vein to any great extent, may do away with the necessity of any operative proceeding. Should the disease be a source of suffering, and interfere with the use of the arm, as in a labouring man for example, it may be readily cured by ligature of the artery at the part wounded.

In venesection puncture of a nerve may sometimes cause mischief. In the Plate several branches of the internal cutaneous nerve cross the median basilic vein, and any of these might be injured; but as their position cannot be ascertained during life, no precaution can be taken to avoid them. Commonly the puncture occasions only pain at the time of bleeding, though in some conditions of the body it may give origin to serious general disturbance of the health.

Inflammation of the vein or phlebitis may result from bleeding; it will require the treatment suited to that affection.

* The Paper on the Treatment of Aneurism before referred to. Medico-Chirurgical Transactions, 1860.

Several other diseased states produced by venesection, with their treatment, were described by Abernethy; and the student who is desirous of obtaining further information may look to the essays of that surgeon.*

The student should observe scrupulously the injunction—never to bleed with a lancet that has been used for other purposes.

BRACHIAL ARTERY AT THE ELBOW.

The lower end of the brachial artery, *l*, which lies under the superficial veins, and may be wounded in venesection, has been laid bare by reflecting a piece, C, of the deep fascia.

In this situation the artery is very near the surface of the limb, and is covered only by the integuments and the deep fascia, B. Along its outer side is placed the biceps muscle, A, which will serve as the guide to the vessel. Underneath it lies the brachialis anticus muscle (Plate iv., F).

One large accompanying nerve, median, 8, is placed on the inner side of the artery, and the median basilic vein crosses over it.

Only superficial offsets are furnished to the integuments from this part of the artery.

Ligature of the artery at the elbow may be necessary in consequence of a wound made with a lancet in venesection, or with any other cutting instrument.

In the case of a wound from accident the vessel requires to be secured by one thread above and another below the injury; and with the surrounding textures infiltrated with blood, the surgeon may experience some difficulty in finding the ends of the vessel, unless he has studied the connections, and practised previously the operation of applying a ligature to the artery in the dead body.

In an operation here for aneurism after a wound, as when the vessel is punctured in venesection, the tumour is to be opened, and the contents of the sac being removed, the arterial trunk is to be tied above and below the opening in it.

* Surgical Observations on Injuries of the Head and on Miscellaneous Subjects, by John Abernethy, F.R.S.; 4th Edit. p. 135: London, 1825.

Cutting on the artery in front of the elbow is an easy operation in the dead body. Taking the inner edge of the biceps muscle as the superficial guide to the position of the vessel, an incision of two to three inches in length, and parallel to the artery, may be carried along the biceps, so as to divide the integuments; and if the median basilic vein comes into view at this stage, it may be drawn inwards. The deep fascia is next to be cut to the same extent, and the wound is to be moved inwards over the line of the artery.

Deep in the wound the firm white median nerve appears on the inner side of the artery, but gradually inclining inwards from it in front of the elbow: this nerve will serve as the deep guide to the vessel, though the operator should be aware that the nerve may be found away from the artery, lying along the inner intermuscular septum of the arm.* The nerve being recognised, the artery is to be sought between it and the edge of the biceps.

Lastly, the sheath of the vessel having been opened, and the venæ comites separated from the artery, the aneurism needle may be passed and the ligature tied in the usual way.

Some unusual conditions of the arteries in front of the elbow deserve consideration in reference to the operation of blood-letting. The occasional presence of an artery in the fat with the superficial veins has been before noticed, p. 34. The number of large arteries beneath the fascia may vary. Commonly there is only one, the brachial; but there may be two, consisting of the brachial trunk and the radial or ulnar; and lastly, three may be occasionally found, resulting from division of the brachial into its usual arteries rather above the elbow-joint, and the unusual origin of the interosseous from the brachial high in the arm.† The possibility of so many arteries being present in one spot must suggest caution to the student about to bleed, and to the surgeon

* I have met with three examples of this condition in the dissecting-room of University College. In another body the nerve was deeper than the artery, and was covered, above the elbow, by fibres of the brachialis anticus.

† The facts here referred to shortly, are stated fully in the Surgical Anatomy of the Arteries by Professor Quain, p. 259.

undertaking the operation of placing a ligature on a wounded artery in front of the elbow.

There is another unusual state of the brachial artery which would give rise to unlooked-for hæmorrhage from a wound in the lower half of the arm.

Sometimes the artery leaves the edge of the biceps, and courses, with or without the median nerve, along the line of the inner intermuscular septum, D. At the elbow it returns to the middle of the limb through the origin of a wide pronator teres muscle, or round a projecting bony point of the humerus (Quain). In such a deviation in the course of the artery, a wound near the elbow on the inner side of the arm, far removed from the line of the biceps muscle, might open this large trunk, and give rise to most alarming, if not dangerous hæmorrhage.

NERVES BEFORE THE BEND OF THE ELBOW.

The anterior cutaneous nerves of the forearm cross the superficial veins in front of the elbow in coursing to their destination.

1. Large internal cutaneous nerve.
2. Small internal cutaneous, or the nerve of Wrisberg.
3. External cutaneous nerve.
4. Anterior part of the large internal cutaneous.
5. Cutaneous offsets to the arm of the internal cutaneous.
6. Posterior part of the internal cutaneous.
8. Median nerve.

The *large internal cutaneous nerve*, 1, enters the fat about midway along the arm, and divides into two parts:—One, 4 (the anterior part), is continued along the front of the forearm to the wrist; the other, 6 (posterior part), ramifies on the back of the forearm on the ulnar side, reaching to the lower third. The primary branches of the nerve lie generally under the median basilic vein, instead of over it, as in this dissection.

Near the arm-pit a cutaneous offset, 5, leaves the trunk to supply the integuments over the biceps muscle.

Small internal cutaneous nerve, 2, or the nerve of Wrisberg. The origin of the nerve is seen in the arm-pit in Plates i. and ii. It pierces the fascia internal to, and lower down than the large

cutaneous nerve, 1; and it ends in the integuments over the back of the elbow. Offsets are directed backwards to the fat and skin of the lower third of the posterior surface of the arm, and one or two communicate with the large internal cutaneous nerve.

In this body the nerve was large, and was placed rather farther forwards than usual.

The *external cutaneous nerve*, 3, or the terminal part of the musculo-cutaneous (Plate ii., 11), appears at the bend of the elbow beneath the median cephalic vein, *f*, and is distributed along the radial side of the forearm as far as the ball of the thumb.

The *median nerve*, 8, is continued to the fingers. At the upper part of the dissection it lies inside and near the brachial artery, but opposite the bend of the elbow it begins to incline inwards from that vessel. In the lower as in the upper part of the arm the nerve serves generally to guide the surgeon in an operation to the situation of the large vessel of the limb.

DESCRIPTION OF PLATE IV.

THE relative position of the muscles, vessels, and nerves of the inner side of the arm, after the removal of the integuments and the deep fascia, is shown in this Plate.

The skin may be reflected in two flaps to the sides, by an incision along the centre of the arm, with a cross-cut at each end. In the fat the superficial nerves and vessels will be found; and the remains of the fat, and the deep fascia, should then be taken away. A small part of the latter has been left near the elbow, for the purpose of marking its position to the superficial veins and the lymphatic glands.

SURFACE MARKING OF THE ARM.

Along the front of the arm is the well-marked muscular prominence so evident in the Plate. Before the removal of the integuments and fascia, this prominence seems to the feel to be

formed by one muscle; but after the dissection has been made, it will be found to consist of the biceps, D, and coraco-brachialis, H, which may be traced upwards under the anterior fold, R, of the arm pit. As the chief muscle, D, acts as a flexor of the elbow-joint, it becomes much enlarged in persons occupied, like blacksmiths, in bending the elbow.

On each side of the swell of the muscles is a surface depression: the two meet below in a hollow in front of the elbow, which contains the superficial veins and nerves; but above they separate, the inner one joining the arm-pit, and the outer one subsides at the insertion of the deltoid muscle, S.

In the inner depression, which is most marked, lies the basilic vein, *g*, with the large internal cutaneous nerve, 4, and lymphatics. These are contained in the fat, and are usually distant a short way from the edge of the biceps. Beneath the fascia of the limb and close to the muscle are placed the brachial vessels, *k*, and the companion median nerve, 7.

The outer depression is less wide and deep, and corresponding with it is the superficial vein, the cephalic, *h*. In it, towards the elbow, the external cutaneous nerve of the forearm makes its appearance through the fascia (Plate iii. 3).

Wounds in the outer bicipital hollow may be large and deep without injuring any important part; whilst in the inner one scarcely a puncture can be made without endangering some vessel or nerve. The issue, seton, and cautery are applied usually at the top of the outer bicipital groove, just below the insertion of the deltoid muscle, because the spot is free from an active subjacent muscle, which might give rise by its contractions to pain in the sore that has been produced.

MUSCLES AND FASCIA OF THE ARM.

The muscles on the front of the humerus which pass over the elbow, viz., the biceps, D, and the brachialis anticus, F, bend the elbow-joint by bringing forwards the bones of the forearm, to which they are fixed. Behind the humerus is a large three-headed or tricipital muscle which is attached likewise to the ulna,

and, drawing backwards that bone, acts as an antagonist to the flexor muscles.

A. Fascia of the forearm.
B. Offset to the fascia from the tendon of the biceps.
C. Inner intermuscular septum of the arm.
D. Biceps flexor brachii muscle.
F. Brachialis anticus muscle.
H. Coraco-brachialis muscle.
K. Inner head of the triceps extensor muscle.
M. Middle head of the triceps.
N. Teres major muscle.
P. Latissimus dorsi muscle.
R. Pectoralis major muscle.
S. Deltoid muscle.

The *deep fascia* of the arm is continuous with that of the forearm, A, and is attached to the prominences around the elbow. C marks the inner intermuscular septum of the arm, which is inserted into the condyloid ridge of the humerus, and gives origin in front to the brachialis anticus, F, and behind to the inner head of the triceps, K. In front of the septum a piece of the fascia has been left with superficial lymphatic glands on it. At B, an offset from the tendon of the biceps joins the fascia.

Biceps brachii muscle, D.—The origin by two heads from the scapula, is shown in Plate ii. Half way along the arm the heads blend in a fleshy belly; and the muscle is inserted below by a tendon into the tubercle of the radius, after giving a fibrous process, B, to the fascia. A third slip or head arises occasionally from the middle of the humerus. If this crosses over the main vessels, as it is directed outwards, it may complicate the operation of tying the artery.

Except at the origin and insertion the muscle is superficial; and it covers partly the other two muscles in front of the humerus, viz., the coraco-brachialis, H, and brachialis anticus, F. Along the inner edge lie the brachial artery, *k*, and the accompanying veins and nerves; and along the outer edge is the cephalic vein, *h*.

The muscle flexes the elbow-joint by acting on either the radius or the humerus, according as the one or the other may be free to be moved. It is also a supinator of the hand. And if the radius is fixed it can assist in carrying the limb forwards from the side. As the muscle contracts in the living body the swell of its belly rises towards the pectoralis major.

The *brachialis anticus*, F, arises from the front of the humerus for the lower half of the bone; and from the intermuscular septum on each side, viz., from all the inner one, but from only the upper part of the outer one, as some muscles of the forearm exclude it below (Plate xii.). It is inserted into the fore part of the coronoid process of the ulna.

Resting on the humerus and the elbow-joint, it is concealed by the biceps, and vessels and nerves. Sometimes a fleshy slip from it covers the brachial artery or the median nerve at the lower part of the arm.

This muscle reaches over the elbow, and is the chief agent in bending that joint.

The *coraco-brachialis muscle*, H, is shown better in Plate ii., to which reference may be made.

The *triceps extensor cubiti* consists above of three parts or heads; and its anatomy will be given more fully in the description of Plate vi.

The middle head, M, arises from the scapula; and the inner and outer heads are attached to the humerus and the intermuscular septa. The insertion of the muscle into the olecranon process of the ulna will be afterwards seen.

In this view of the parts the middle head lies beneath the teres major, N, and latissimus dorsi, P, and touches the brachial vessels and their companion nerves for one to two inches. And the inner head surrounds the ulnar nerve, 8, and the inferior profunda artery, *n.*: this is more evident in Plate vi.

The *teres major*, N, and *latissimus dorsi*, P, coming forwards to their insertion into the humerus, bound behind the hollow of the axilla (Plate i.).

The *pectoralis major*, R, curves over the muscles of the front of the arm as it passes from the thorax to its insertion into the humerus. At its attachment to the bone, it joins the deltoid muscle, S.

VEINS OF THE ARM.

The superficial veins of the limb diminish in number from the hand upwards. At the elbow they blend into two, which have a

constant course on the sides of the biceps to the axilla. A somewhat different arrangement from that in Plate iii. is here noticeable.

a. Median vein of the forearm.
b b. Anterior ulnar veins.
c. Posterior ulnar vein.
d. Median cephalic vein.
f. Median basilic vein.
g. Basilic vein of the arm.
h. Cephalic vein of the arm.
s. Companion vein of the brachial artery.

The *median vein*, *a*, splits in the usual way into two branches, which are directed outwards and inwards to receive the radial and ulnar veins. In this body the anterior ulnar veins, *b*, *b*, were large, and joined the median basilic, *f*, at separate points, after being united by a cross branch.

The *basilic vein*, *g*, formed by the union of the median basilic and anterior ulnar veins near the elbow, ascends in the fat to the middle of the arm; then piercing the deep fascia, it is directed onwards to the axilla by the side of the brachial artery, and becomes the axillary vein at the lower border of the teres major muscle. Soon after it sinks through the fascia it communicates usually with one of the companion veins, *s*, of the brachial artery.

Cephalic vein, *h*.—Only the upper part of this vein is visible as it crosses between the muscles great pectoral, R, and deltoid, S, to end in the axillary vein. Springing below from the junction of the median cephalic, *d*, with the radial vein, it ascends in the fat to the shoulder outside the biceps muscle. An unusual superficial artery accompanied it in this dissection.

Venæ comites.—The companion veins of the brachial artery, two in number, lie one on each side of that vessel, and join at intervals by cross branches; the inner one is marked *s* in the Plate. Receiving small veins which accompany the branches of the artery, they join commonly into one at the lower part of the axilla, and end in the axillary vein near the lower border of the subscapularis muscle (Plate ii. *k*).

ARTERIES OF THE ARM.

The brachial artery and the end of the axillary trunk may be studied in this dissection with their connections undisturbed. The ramifications or ending of the branches must be learnt with the aid of the other Plates.

k. Brachial artery.
* Spot best suited for ligature of the vessel.
l. External mammary branch of the axillary artery.
m. Muscular offset of the superior profunda branch.
n. Inferior profunda branch.
p. Anastomotic branch.

The *brachial artery*, *k*, extends from the lower border of the teres major muscle, N, to a finger's breadth below the bend of the elbow (Quain), where it bifurcates into the radial and ulnar arteries. The inner edge of the muscular prominence of the coraco-brachialis and biceps marks its position in the limb ; or a line from the arm-pit to the middle of the bend of the elbow would correspond with the course of the vessel.

In consequence of its superficial position in the arm the vessel can be readily compressed. Above the spot marked with an asterisk the artery lies inside the humerus, and the pressure should be directed outwards against the bone ; but below that spot it inclines in front of the bone, and the blood will be stopped in it by forcing backwards the fingers or the thumb.

Its connections with muscles and fascia are the following : Beneath it, from above down, are the long head of the triceps, M ; the inner head, K, of the same muscle ; the coraco-brachialis, H, where the asterisk is placed ; and thence to the ending, the brachialis anticus, F. Superficial to the artery is the deep fascia of the limb with the integuments.

Two companion veins are close to the brachial trunk—one on each side—and anastomose across it after the manner of such veins ; and at the bend of the elbow the median basilic vein, *f*, crosses the artery. The basilic vein, *g*, lies inside the line of the deep vessels—sometimes nearer, and at others farther from them.

Several nerves accompany the artery above, but only one below.

The median nerve, 7, keeps close to the vessel throughout, except in front of the elbow, where it inclines away to the inner side ; as low as the part marked thus * it is outside the vessel, then it crosses gradually over, though occasionally under the artery, and gains the inner side about two inches above the elbow. The ulnar nerve, 8, lies inside and in close contact with the artery nearly to the asterisk, but at that spot it diverges from the vessel and courses along the inner intermuscular septum. The musculo-spiral nerve is placed behind the upper part of the artery for two inches (see Plate vi.). The large internal cutaneous nerve, 4, rests on the upper third of the brachial artery ; but in some bodies it is moved farther in, as in the dissection from which the drawing was taken.

Position and names of the branches.—Besides small muscular and cutaneous offsets, four named branches spring from the brachial trunk. The highest and largest, *upper profunda*, leaves the back of the artery about an inch from the beginning. The next largest, the *inferior profunda*, *n*, arises near the upper end of the inner intermuscular septum. A *nutritive artery* of the shaft of the humerus begins near the last, and is covered by the biceps. Another small branch, the *anastomotic artery*, *p*, leaves the parent trunk near the elbow.

All the branches are small except the superior profunda ; and no two arise at opposite sides of the trunk to interfere by a cross current with the healing process after a thread has been put on it. Almost any point would therefore be available for the application of a ligature, but the spot generally selected is marked with an asterisk in the Plate, the vessel being here free from any large offset, and being firmly supported by the coraco-brachialis and the humerus.

Ligature at the middle of the artery.—This operation on the brachial trunk, without a wound at the spot where it is tied, is sometimes rendered necessary by an aneurism or by hæmorrhage from a vessel lower in the limb.

Under ordinary circumstances the operation is not difficult, as the brachial trunk is so near the surface, and the guides to the vessel are good. The superficial guide to the position of the

artery is the inner edge of the biceps muscle; and the deep guide during the operation is the large median nerve.

When the vessel is to be secured the operator stands on the inner side of the limb, and fixing his eye on the spot thus marked *, makes a cut two to three inches long on the biceps muscle near the inner edge, but not over the vessel. The skin, fat, and deep fascia are to be divided down to the fleshy fibres; and the incision is then to be moved inwards over the line of the brachial artery, the loose skin readily allowing this shifting of its position.

Bending now the elbow to relax the biceps muscle and allow of its being kept out of the way, the firm median nerve is to be looked for close to the edge of the biceps, where it lies outside the vessel, or is coming inwards over the arterial trunk. The median nerve being found, and the knife having been carried along it to divide its sheath, is next to be drawn inwards from the edge of the biceps with a narrow retractor, but special care must be taken not to drag the artery out of place with the nerve. Within the space limited by the nerve on the one side and the muscle on the other, the operator seeks the artery by cutting away the fat bit by bit.†

Supposing the artery recognised, its sheath is to be seized with the forceps, and a piece is to be cut out, care being taken that the point of the scalpel does not injure the vessel beneath. Without loosing the sheath from the forceps a blunt instrument, like the point of a director, may be inserted into the hole of the sheath to separate the artery; and on its withdrawal the aneurism needle is to be carried round the vessel in the same channel. The surgeon avoids detaching the artery from its sheath more than is required for the passage of the needle, for separation of the two destroys the vasa vasorum, occasioning the death of the

† Some experience in superintending the operations of students on the dead body has convinced me of the expediency of directing the nerve to be drawn inwards. If this mode of proceeding is not adopted, the beginner comes upon the ulnar nerve and the basilic vein, which he may mistake for the median nerve and the brachial artery.

arterial coats, and, as a consequence, hæmorrhage may follow the separation of the ligature.

Let the ligature be put on the vessel as high as the sheath is detached; and before tying it, pressure should be used for the purpose of ascertaining whether the circulation through the chief vessels of the limb can be arrested. Should the pulse still beat as before at the wrist, the existence of more than one arterial trunk may be suspected; and the operator, after tying the one, seeks another by its side. If two arteries are present both are to be secured, for the object in view when putting a ligature on the brachial trunk, is to stop the entrance of the blood into the limb through the main vessel, and to ensure its coming in only slowly, and through the anastomosing channels.

Before an attempt is made to place a ligature on the brachial trunk, the difficulties likely to arise from different states of the artery or of the surrounding parts should be well considered.

An unusual position of the brachial artery has been observed. In the condition referred to the vessel separates from the biceps above, or about midway between the arm-pit and elbow, and courses through the arm along the inner intermuscular septum, C (p. 39). So, in an operation at the usual spot, if the main blood-vessel cannot be found by the side of the muscle, it should be sought farther in, or nearer the inner border of the limb.*

There may be more than one large artery in the limb as before said. Two vessels have been found as frequently as 1 in 5, and the surgeon may expect therefore to meet with this condition.† When two vessels are present they usually lie side by side in the place of the brachial, and their existence might be inferred in an operation in consequence of the smaller size and more superficial position of the vessel found. But sometimes the two are sepa-

* Two instances of this kind were met with during operations on the dead body, and have been put on record by Mr. Quain: "Commentaries on the Arteries," p. 259. I have observed a similar unusual place of the artery, with difficulty in finding the vessel, whilst I was superintending the operations of students.

† The Anatomy of the Arteries, by Mr. Quain.

rated by an interval : thus, one, the smallest (radial) may lie in the place of the brachial trunk ; and the other, the larger artery, may be moved inwards from the edge of the biceps to the inner intermuscular septum.

The depth of the artery varies with different states of the biceps muscle. Sometimes the brachial trunk is covered, at the spot where ligature is practised, by a fleshy slip of origin of the biceps from the humerus. The presence of fleshy fibres over the artery would cause some embarrassment to an operator unacquainted with this fact ; and the knowledge of the occasional existence of this condition teaches that a previous examination of the arm should be made, with the view of detecting it by difference in the force of the pulsations of the artery.

Change in the position of the median nerve with respect to the brachial artery may bring danger in an operation, as the nerve serves as the deep guide to the vessel. In the ordinary arrangement the nerve is superficial to the artery, and is met with first ; but not unfrequently it crosses under the artery, and would not be found so soon as the vessel. When this last named position of the nerve exists, the danger of wounding the artery or its companion veins is increased in consequence of these being nearer the surface, and being reached unexpectedly.

Branches of the artery.—The offsets of the artery are small and numerous, but only a few have received names. After supplying the muscles and contiguous parts the chief branches course to the elbow, and join branches from the forearm.

The *superior profunda branch* arises from the trunk of the artery above the letter, *k*, and winds to the back of the arm, where it ramifies in the triceps, and ends at the elbow. (See Plate vii.) One offset is marked, *m*, in the drawing.

The *inferior profunda*, *n*, arises near the spot chosen for ligature of the trunk, and runs along the ulnar nerve to the elbow : it anastomoses with the posterior recurrent branch of the ulnar artery.

The *nutritive artery of the shaft of the humerus* arises between *k*, and *, and entering an osseous canal, supplies the medullary structure of the bone.

The *anastomotic branch*, *p*, is directed inwards through the inner intermuscular septum, and communicates with the inferior profunda. An offset descends in front of the elbow joint, supplying the brachialis anticus and one or more muscles of the forearm, and anastomoses with an anterior recurrent branch from the ulnar artery.

Muscular offsets spring from the trunk at intervals, and supply the muscles on the fore part and the back of the humerus.

Small *cutaneous* offsets to the arm are shown coming from the end of the brachial, and the end of the axillary artery.

Anastomoses of the branches.—After ligature of the brachial artery the blood is conveyed into the limb by the anastomosis of the branches arising above the spot tied with those beyond. Thus the superior profunda joins behind the elbow with the anastomotic and the recurrent interosseous, and on the outer side with the recurrent branch from the radial artery (Plate vii). The inferior profunda communicates with the anastomotic, and with the posterior recurrent of the ulnar (Plate viii.). And the anastomotic branch transmits its blood to the anterior recurrent branch of the ulnar (Plate viii.). The artery entering the shaft of the humerus will anastomose above and below with the vessels supplied to the ends of the bone.

NERVES OF THE ARM.

All the nerves included in this dissection are derived from the brachial plexus in the axilla, with the exception of the small offsets over the shoulder, which come from the cervical plexus in the neck. Only a part of each trunk is laid bare, as it passes onwards to its destination in the forearm.

1. Internal cutaneous branch of the musculo-spiral.
2. Branch of musculo-spiral to the inner and middle heads of the triceps.
3. Nerve of Wrisberg or small internal cutaneous.
4. Internal cutaneous (large).
5. Anterior branch of the internal cutaneous.
6. Posterior branch of the internal cutaneous.
7. Median nerve.
8. Ulnar nerve.
9. Branches of the cervical plexus.

The trunk of the *musculo-spiral nerve*, lying beneath the brachial artery, furnishes a cutaneous branch, 1, to the integuments of the back of the arm; this reaches as far as the lower third, or sometimes nearly to the elbow. A muscular branch, 2, to the inner head, K, and the middle head, M, of the triceps, arises in common with the preceding.

The *nerve of Wrisberg*, 3, and the *large internal cutaneous*, 4, pierce the fascia of the arm rather below the middle, and are distributed to the integuments of the back of the arm and to that of the forearm: their position to the brachial artery may be noticed. Usually the cutaneous nerve, 4, lies over the upper part of the artery. Its place at the elbow under the median basilic vein is regular: for another arrangement, see Plate iii.

The *median nerve*, 7, takes the same course in the arm as the brachial artery, and lies close to the vessel (p. 46). Outside the artery above, and inside below, it crosses over the blood vessel, and is found on the inner side about two inches above the elbow. Sometimes the nerve passes under instead of over the artery in its change of position from the one side to the other. No branch is distributed from it in the upper arm.

Being the companion nerve to the main artery, it changes generally its place when the vessel deviates from the usual site. Thus in those instances in which the brachial artery courses along the inner intermuscular septum to the elbow the nerve may be found with it; but the nerve may be near the septum without the blood vessel (p. 38). A wound just above the elbow, in such a case, might cut through the nerve, and interfere with the actions of the parts supplied by it; or from the close contiguity of the ulnar and median nerves, one being before and the other behind the intermuscular septum, C, the same wound dividing both trunks would cause loss of power in the muscles on the front of the limb below the elbow, with insensibility in the fingers and the palm of the hand, and in part of the back of the hand.

The *ulnar nerve* passes through the upper arm without branching, and enters the forearm behind the elbow-joint. As far as the middle of the arm the nerve is close to, and rather

behind the artery; but it separates afterwards from the vessel, passing through the intermuscular septum, and is continued behind this piece of fascia to the hollow between the olecranon and the inner condyle of the humerus. Pressure applied to it behind the joint causes a peculiar tingling along the inner side of the hand and in the inner two fingers.

LYMPHATICS OF THE ARM.

Superficial lymphatics accompany the superficial veins in the arm; and the greater number lie along the inner part of the limb. Above the elbow are some superficial lymphatic glands in front of the intermuscular septum, which are marked thus, † † †. Three glands were present in the dissection; these are the lowest superficial glands in the limb. Enlargement of these glands may be brought on by causes which induce inflammation and swelling of lymphatic glands elsewhere; and a small tumour in this part of the arm may be owing to increase of one of the glands.

Deep lymphatics with their appertaining glands course with the trunks of the blood vessels beneath the fascia, and enter the glands in the axilla.

DESCRIPTION OF PLATE V.

THIS view exhibits the dissection of the shoulder and of the superficial muscles and vessels of the back of the scapula.

On the detached limb this dissection follows the examination of the subscapularis muscle on the under surface of the scapula; and it is readily made by reflecting the integuments and the deep fascia from before backwards towards the lower angle of the blade-bone. By cutting through the deltoid near its upper attachment, the vessels and nerve beneath it can be traced out.

MUSCLES OF THE SCAPULA, SHOULDER, AND ARM.

Three groups of muscles are laid bare more or less completely in the dissection, viz., muscles of two borders of the scapula, of the posterior surface of that bone, and of the shoulder and the back of the arm.

All the muscles passing between the humerus and the scapula are relaxed, and are consequently wide and hanging; but in Plate vi. the muscles are shown on the stretch, where the difference in their form and position may be noted.

The dorsal muscles of the scapula cover the shoulder-joint, and will receive injury in dislocation of the head of the humerus.

A. Rhomboideus major.
B. Rhomboideus minor.
C. Levator anguli scapulæ.
D. Teres major.
E. Latissimus dorsi.
F. Long head of the triceps.
G. Outer head of the triceps.
H. Supra-spinatus.
K. Infra-spinatus.
L. Teres minor.
N. Deltoid muscle.
O. Fascia on the dorsal scapular muscles.

The three muscles marked A, B, C, arise from the spinal column, and are fixed into the base of the scapula.

The *rhomboideus major*, A, is inserted between the spine and the lower angle of the bone.

The *rhomboideus minor*, B, is attached opposite the smooth surface at the root of the spine.

The *levator anguli scapulæ*, C, is fixed above the last, reaching from it to the upper angle of the shoulder-blade.

From the direction of their fibres they would aid, when acting without the trapezius, in lowering the point of the shoulder, by raising and bringing towards the spinal column the lower angle and base of the scapula.

Connected with the inferior border of the scapula are the teres major and the long head of the triceps; and the latissimus dorsi crosses the others, resting on the inferior angle of the bone.

The *teres major*, D, arises from a special impression on the lower angle of the scapula, from the deep fascia covering the dorsal

scapular muscles, and from the lower edge of the scapula as far forwards as an inch from the long head of the triceps. It bounds the axilla behind, and lies in front of the long head of the triceps (Plates i. and ii.).

The muscle diverges in front from the axillary border of the scapula, leaving a triangular interval between it and the bone; and it is concealed partly by the latissimus dorsi, E, when viewed from behind.

The *latissimus dorsi*, E, is attached to the lower part of the trunk of the body by the one end, and to the humerus by the other. Winding over the lower angle of the scapula and the teres major, it ascends in front of the teres to its insertion into the bicipital groove (Plate ii.).

In the dissection the muscle slipped down somewhat in consequence of its relaxed condition, but its natural place on the angle of the scapula is displayed in Plate vi.

These two muscles could draw the arm to the scapula if the member was at a distance from the trunk, or if the limb was fixed, as in climbing, they would help to approximate the trunk to the raised limb.

And when the latissimus has drawn the humerus backwards, it will rotate inwards the bone. If the lower end of the raised humerus is not free to move, this muscle acting with the teres and pectoralis major draws down the upper end, and may dislodge the head from the articular surface of the scapula.

The dorsal scapular muscles, H, K, and L, cover the shoulder-joint above and behind, and converge to the head of the humerus. A deep fascia covers the muscles, and gives origin to the fleshy fibres: one piece dips between the two infra-spinous muscles, K and L, and is fixed to the scapula.

The *supra-spinatus muscle*, H, fills the hollow above the spine of the scapula. Arising from the bone and the fascia, it passes over the shoulder-joint to be inserted into the upper impression on the great tuberosity of the humerus.

The *infra-spinatus muscle*, K, is named from its position below the spine of the scapula. It arises, like the preceding, from the underlying bone and the fascia stretched over it, and, crossing the

shoulder-joint, is inserted into the middle impression on the great tuberosity of the humerus.

The superficial fibres from the spine of the scapula and the fascia are directed forwards over the fibres coming from the blade part of the bone.

The *teres minor*, L, arises by the side of the infra-spinatus from the fascia, and from a special impression along the axillary border of the scapula. Covering the joint, it is inserted into the lowest mark on the great tuberosity of the head of the humerus, and into the bone below by a few fleshy fibres.

The three muscles above noticed are called "articular" from touching the joint. When in action they cause the humerus to move in the following directions. If the bone is hanging the supra-spinatus will assist the deltoid in raising the arm. The infra-spinatus and teres minor acting together will draw backwards the point of bone to which they are fixed, becoming external rotators. If the humerus is already elevated the two last muscles below the scapular spine will assist the deltoid in bringing back the arm.

They suffer more or less injury in dislocations of the shoulder-joint. Should the humerus be dragged downwards from its socket all three may be torn across ; or, the muscles remaining whole, a shell of bone, into which they are inserted, may be detached from the humerus. In dislocation backwards the head of the humerus lies under the infra-spinatus, K, and teres minor, L, which are relaxed ; and the supra-spinatus is directed backwards and made tense round the spine of the scapula. But supposing the bone dislocated forwards (on to the other side of the scapula), the infra-spinal muscles will be much stretched if not torn.

The two arm muscles are the deltoid, forming the prominence of the shoulder, and the triceps, which lies behind the arm bone.

The *deltoid muscle*, N, arises from the scapular arch opposite the attachment of the trapezius, viz., from the outer third of the clavicle, and from the acromion and the lower edge of the spine of the scapula as far back as the posterior smooth triangular surface, where it blends with the deep fascia covering the infra-spinous muscles. It narrows below, and is inserted into an impression on

the outside of the humerus above the middle. Sufficient of the muscle has been divided to show beneath it the head of the humerus, the insertion of the dorsal scapular muscles, and the posterior circumflex artery, *a*, and nerve, 1.

Between the acromion process and the deltoid muscle, on the one side, and the head of the humerus with the dorsal scapular muscles on the other, is a bursa—one of the largest in the body—which lubricates those surfaces in the movements of the arm. In chronic rheumatic arthritis, when the surrounding capsule and muscles are destroyed, this bursa communicates with the articulation—the deltoid and acromion becoming incasing structures of the shoulder-joint.

When taking its fixed point above, this muscle is the chief elevator of the humerus, and it can carry backwards and forwards the raised limb; but in all these movements it is assisted by the scapular muscles. The arm is raised by the central fibres of the deltoid and the supra-spinatus muscle, H; it is moved forwards by the clavicular fibres and the subscapularis; and it is carried back by the fibres attached to the spine of the scapula, and by the infra-spinatus, K, and teres minor, L.

Supposing the deltoid to act from the humerus, as in drawing along the body by the arms, the muscle serves as the chief bond of union between the shoulder and arm bones.

Triceps extensor cubiti.—Two heads of this muscle, outer and middle, are visible in this dissection.

The outer head, G, attached to the upper part of the back of the humerus, reaches nearly as high as the insertion of the teres minor, L, and is covered by the deltoid.

The middle or long head, F, is fixed to the inferior costa of the scapula close to the shoulder-joint. This part enters between the two teres muscles (over the major and under the minor) and divides into two the triangular space included by them. In front of this head, between it and the humerus, is a quadrangular interval, through which the posterior circumflex vessels and nerve turn from the axilla; and behind the head is an opening triangular in shape, which transmits the dorsal branch of the subscapular artery.

A knowledge of the attachments of the muscles to the upper part of the humerus will be useful in attempts made to counteract in fracture the displacement of the fragments. In fracture of the neck of the bone near the teres minor insertion the upper end, into which the three dorsal scapular muscles are inserted, will be fixed in the glenoid hollow, and tilted rather outwards; whilst the lower end will be inclined inwards towards the trunk by the latissimus dorsi, teres major, and pectoralis major, pulling in the direction of their fibres, and it will be finally carried upwards inside the upper fragment by the contraction of the muscles coming from the scapula to the humerus, viz., deltoid, coraco-brachialis, and triceps.

In an oblique fracture lower down (about opposite N on the deltoid) the relative position of the fragments to each other would be reversed. In that case the upper fragment will be drawn inwards towards the trunk by the latissimus, teres major, and pectoralis major; but though the lower end of the humerus will be elevated by the muscles descending from the scapula, as before said, it will be placed outside the upper end by the power of the deltoid muscle.

ARTERIES OF THE SHOULDER.

The shoulder possesses few vessels in comparison with some other parts. Two small arteries with their veins are met with in this region, and they are derived from the axillary trunk.

The *posterior circumflex artery*, *a*, one of the lowest branches of the axillary trunk (Plate i. *h*), appears between the humerus and the long head of the triceps; and winding forwards round the shaft of the humerus, it ends on the under surface of the deltoid muscle.

It supplies chiefly the deltoid, but offsets enter also the teres minor, and the long head of the triceps. Some branches are given to the head of the humerus, and anastomose in front with the anterior circumflex. A cutaneous offset descends to the integuments over the deltoid.

In the operation of amputation at the shoulder-joint the assistant follows the knife with his hand to seize the large axillary

artery when it is divided, but he cannot compress at the same time the circumflex artery placed much farther back. This vessel pours out blood freely, and it may be secured first, provided the assistant controls the bleeding of the axillary trunk.

The *dorsal scapular artery*, *b*, is an offset of the subscapular branch of the axillary (Plate ii. *f*). Appearing through the triangular space behind the long head of the triceps, it bends round the edge of the scapula under the teres minor, and ramifies in the infra-spinal fossa.

As it is about to enter the fossa a branch is directed along the inferior border of the scapula, between the teres muscles, to which and the integuments it is distributed.

NERVE OF THE SHOULDER.

A large nerve from the brachial plexus ramifies under the deltoid muscle.

The *circumflex nerve*, 1, which is delineated in Plate i. 12, accompanies the posterior circumflex artery to the shoulder. Like the vessel it ends mostly in the deltoid muscle, supplying offsets to the fleshy fibres as it winds over the humerus.

Close to the border of the teres minor a considerable branch, 2, breaks up into offsets to the teres, the back of the deltoid, and the integuments covering the lower part of the deltoid muscle. In the natural position of the integuments the cutaneous branch would wind forwards over the muscle.

On the branch to the teres minor, 3, there is usually an enlargement of a reddish colour and elongated form, which has been designated a "gangliform swelling." Before the nerve is disturbed that swelling lies close to the teres muscle.

In consequence of the loop made by the circumflex nerve under the head of the humerus, compression of it with impairment of function follows dislocation downwards of that bone. Paralysis of the deltoid muscle, and inability to raise the arm, will be consequent on considerable disease or injury of the circumflex nerve.

DESCRIPTION OF PLATE VI.

THE triceps muscle at the back of the arm and some of the shoulder muscles are here displayed. Whilst the drawing was in progress the body was raised on blocks, and the arm was fastened over the side of the table.

To lay bare the triceps carry an incision along the back of the arm, and reflect the integuments and the deep fascia beyond the elbow. Usually the limb has been separated from the trunk before the student undertakes the dissection ; and in such case the triceps muscle may be made tense by a block beneath the elbow.

MUSCLES OF THE ARM AND SHOULDER.

On the back of the humerus lies the large triceps muscle, which extends the elbow-joint.

The shoulder muscles have been described with Plate v., and will require but little additional notice ; the scapular muscles are more stretched in this than in the preceding Plate.

A. Rhomboideus major.
B. Latissimus dorsi.
C. Teres major.
D. Teres minor.
E. Infra-spinatus.
F. Deltoid muscle.
G. Inner head of the triceps.
H. Middle head of the triceps.
K. Outer head of the triceps.
L. Tendon of the triceps.
N. Fascia over the infra-spinatus.
O. Fascia of the arm.
P. Spine of the scapula.

The *triceps extensor cubiti* is undivided below, but is split into three processes of origin above, viz., the outer, middle, and inner heads.

The outer head, K, is attached along the upper half of the posterior surface of the humerus above and external to the groove for the musculo-spiral nerve and its vessels, reaching upwards nearly to the teres minor (Theile).* This attachment is shown in Plate vii.

* See a foot-note to the description of the triceps in Plate VII.

The inner head, G, larger below than above, and concealed by the middle head, arises from the hinder surface of the humerus below the winding groove, extending laterally to the intermuscular septa, and upwards to the insertion of the teres major (Theile). See Plate vii. for its extensive origin.

The middle or long head, H, reaches the inferior or axillary border of the scapula, from which it arises for about an inch.

The outer and middle heads blend about the middle of the arm, but the inner one joins lower down. The muscle ends below in a wide, strong tendon, which receives deep fleshy fibres down to the elbow joint, and is inserted into the end of the olecranon —a small bursa lying between the tendon and the tip of that process.

This muscle is represented in the thigh by the extensor muscles of the knee-joint. It is subcutaneous except above, and it is separated laterally from the muscles in front of the humerus by processes of fascia—the intermuscular septa. The long head lies between the teres muscles.

By the action of this muscle the elbow-joint will be extended; and if the limb is removed from the body it can be approximated to the trunk by the long head. But should the upper limbs be fixed at a distance from the side, the muscle can assist in moving the trunk (through the scapula) towards the fixed arm, as in dragging the body forwards by a rope.

When the olecranon process of the ulna is detached by fracture, it is drawn upwards by the triceps, as far as the lower fleshy fibres of the muscle will allow, in the same manner as the upper fragment of the patella, in transverse fracture of that bone, is carried upwards by the extensor cruris. When replacing the displaced fragment force is not to be employed alone for the purpose of drawing it down towards the end of the ulna; but the interval is to be diminished also by moving backwards the shaft of the ulna in extension of the elbow-joint.

In dislocation forwards of the humerus the olecranon becomes very prominent behind the elbow, and the tendon of the extensor muscle stands out from the humerus something like the tendo

Achillis in the leg. Some of the lower fleshy fibres will be broken through by the humerus being forced from the tendon.

By the action of the triceps, fracture of the lower end of the humerus near the elbow may be made to resemble the dislocation above noticed; for the lower end of the bone entering into the elbow-joint is forced upwards behind the rest of the shaft by the contracting muscle, and the olecranon is rendered more than usually prominent. But the nature of the injury may be made out by attention to the place of the olecranon:—in a dislocation this point of bone projects much beyond, and is higher than the condyles of the humerus; but in fracture of the bone it is not more prominent with respect to the condyles than in the other limb, and it retains its usual position on a level with them.

Deltoid muscle, F.—At the origin of this muscle from the spine of the scapula it is tendinous behind, and blends with the fascia covering the infra-spinate muscle. The hinder part of the muscle has been turned forwards to allow a sight of the circumflex vessels and nerve beneath.

Latissimus dorsi, B.—The muscle has been cut and thrown down as it crosses the angle of the scapula; the extent to which it covers that point of bone and the rhomboideus major and teres major muscles may be observed.

ARTERIES OF THE ARM AND SHOULDER.

The trunk of the brachial artery and some of its offsets are met with in the dissection of the back of the arm. Branches of the axillary artery are distributed to the shoulder.

a. Dorsal scapular artery.
b. Circumflex artery.
c. Muscular offset of the superior profunda artery.
d. Muscular branch of the brachial.
e. Trunk of the brachial.
f. Muscular branch of the brachial.
g. Inferior profunda artery.

The *brachial artery*, *e*, is visible from behind where it lies inside the humerus, but it disappears below by passing in front of the arm bone. Contiguous to the upper part of the artery is the triceps muscle, viz., the middle head, H, and the inner head, G.

A large companion vein (the continuation of the basilic) is placed on the inner side.

Close inside the artery is the ulnar nerve, 3; and intervening between it and the middle head of the triceps is the musculo-spiral nerve, 4.

Two *muscular offsets*, *d* and *f*, enter the long head of the triceps.

The *upper profunda*, or the muscular artery of the back of the arm, is concealed by the middle head of the triceps; an offset, *c*, from it enters the outer head of the muscle. The distribution of this branch is represented in Plate vii.

Inferior profunda artery, *g*.—Winding backwards from the brachial (Plate iv.), it accompanies the ulnar nerve, 3, to the interval between the olecranon and the inner condyle, where it joins a branch of the ulnar.

The *dorsal scapular artery*, *a*, courses under the teres minor muscle, p 58. Amongst the surrounding muscles supplied by it is the deltoid, to which it gives an offset: this was cut through in the dissection.

The position of the *posterior circumflex artery*, *b*, to the deltoid appears in this view of the parts. Some of its muscular offsets, and the branch to the integuments, are apparent.

NERVES OF THE SHOULDER AND ARM.

The nerves of the shoulder and back of the arm are branches of the brachial plexus, and have been partly represented in other dissections.

1. Circumflex nerve.
2. Offset of the musculo-spiral to the middle head of the triceps.
3. Ulnar nerve.
4. Musculo-spiral nerve.

Circumflex nerve, 1.—The anatomy of the trunk of the nerve can be studied in Plate v. Its cutaneous offset retains its natural place in this dissection.

The *musculo-spiral nerve*, 4, winds from the inner to the outer side of the limb between the humerus and the triceps muscle

(Plate vii.). The figure, 2, marks an offset from it to the middle head of the triceps.

The *ulnar nerve*, 3, lies along the inner side of the arm as far as the elbow (Plate iv.). In the lower half of its course it is placed at the back of the limb, behind the inner intermuscular septum, and is partly concealed by fibres of the inner head of the triceps.

In excision of the articular ends of the bones of the elbow-joint through the triceps, the ulnar nerve is liable to be cut. To secure it from accident the nerve is dislodged from its hollow during the operation, and is moved to the front of the projecting inner condyle of the humerus. Temporary loss of the power of contracting in the muscles, and of feeling in the integuments of the inner part of the forearm and hand, follows division of the nerve; and this lost power would not be regained till the nerve structure has been repaired.

DESCRIPTION OF PLATE VII.

DISSECTION of the musculo-spiral nerve at the back of the arm, with its accompanying artery—the profunda.

Supposing the triceps denuded, as in Plate vi., the middle and outer heads are to be cut through after the manner shown in the figure, to trace the nerve and its vessels. At the outer part of the muscle, a small branch of nerve and artery should be followed through the fleshy fibres to the anconeus muscle of the forearm.

MUSCLES OF THE ARM AND SHOULDER.

After the triceps has been divided in the way indicated, the attachment to the humerus of the inner and outer heads becomes evident.

The shoulder muscles have been displaced but little during the dissection, but they are shown on the stretch in consequence of the limb being placed in a hanging posture.

A. Lower end of the long head of the triceps cut through.
B. Upper end of the long head of the triceps.
C. Outer head of the triceps.
D. F. Inner head of the triceps.
E. The nerve and vessels to the anconeus.
G. Anconeus muscle.
H. Supinator longus muscle.
K. Teres minor muscle.
L. Infra-spinatus muscle.
M. Latissimus dorsi muscle.
N. Teres major muscle.
P. Deltoid muscle.
Q. Outer condyle of the humerus.
R. Olecranon process.
S. Fascia of the forearm reflected.

Triceps extensor brachii.—The superficial view of this muscle, and the attachment of the middle head can be seen in Plate vi. Only the origin of the outer and inner heads will be noticed below.

The outer head, C, arises at the back of the humerus above the groove in the bone, which lodges the musculo-spiral nerve and the vessels; it narrows as it ends above near the insertion of the teres minor.

The inner head, D, and F, arises from the back of the humerus below the winding groove, reaching upwards by a pointed part as high as the teres major muscle—sometimes to the upper, and sometimes the lower border. This head is wide below, and reaches laterally to the intermuscular septa, from which fibres take origin.*

Subanconeus.—Some of the deepest fibres of the triceps near the elbow end in the capsule of the joint, like fibres of the extensor of the knee, and are said to constitute a separate muscle, to which the name subanconeus has been applied; but I have not observed such isolated and distinct muscular bands as anatomists describe.

Supinator longus muscle, H.—Covered by the fascia of the limb the muscle is fixed to the outer condyloid ridge of the humerus, as high as the groove before referred to. This muscle and the extensor carpi radialis longus occupy the ridge—the former reach-

* This statement of the origin of the inner and outer heads of the triceps differs much from the common anatomical description. It contains the view of Theile, and has the merit of being simple. The original account is given in Müller's Archiv für Anatomie, &c., for 1839, p. 420—"Ueber den Triceps brachii und den flexor digitorum sublimis des Menschen."

ing the two upper thirds, and the latter, the lower third. Above the upper border of the supinator the musculo-spiral nerve and vessels are directed forwards.

The group of shoulder muscles is strained by the weight of the arm, as in Plate vi.

Naturally the *teres minor muscle*, K, is not so covered by the long head of the triceps ; but as this was cut, and the limb hanging, the upper end, B, was pushed back by the latissimus dorsi arching in front.

The *latissimus dorsi*, M, and *teres major*, N, are stretched as they descend to the humerus. Only the upper edge of the teres appears ; below and in front they are blended by tendinous fibres.

By the weight of the limb the *deltoid muscle*, P, is made to look flatter than it is usually.

VESSELS OF THE BACK OF THE ARM.

The ramifications of the superior profunda artery through the triceps, and its origin from the brachial trunk are contained in the region dissected. Some small branches of the circumflex artery appear behind the border of the deltoid.

a. Brachial artery.
b. Basilic vein becoming axillary.
c. Superior profunda artery.
d. Offset of the profunda to the front of the arm, with the musculo-spiral nerve.
f. Branch of artery along the outer intermuscular septum.
g. Inosculating artery from the recurrent radial.
h. Anastomotic branch from the interosseous recurrent artery.
k. Muscular branch of the artery to the triceps and anconeus.
l. Branch of artery to the teres minor from the posterior circumflex.
m. and *n*. Cutaneous and muscular offsets of the posterior circumflex artery.

Brachial artery, a.—The anatomy of the brachial trunk issuing from the armpit has been described with Plate vi. p. 61. The following large muscular offset springs from this part of the artery.

The *superior profunda* branch, *c*, is the nutritive and anasto-

motic vessel of the back of the arm, and corresponds in the thigh with the profunda artery of the femoral trunk. Springing from the brachial, near the axilla, it is the largest offset of that vessel, and winds behind the humerus in the hollow separating the inner and outer heads of the triceps, as far as the outer side of the limb, where it ends in muscular, anastomotic, and cutaneous offsets.

The *muscular branches* supply the three heads of the triceps, viz., the long head, A, the external, C, and the internal, D. A second artery enters the long head from the brachial trunk.

The *anastomotic offsets*, three in number, spring from the end of the profunda. One, *b*, variable in size, accompanies the musculo-spiral nerve to the front of the arm, and communicates with the radial recurrent. A second, *f*, runs on the intermuscular septum to the outer condyle, and anastomoses with a branch, *g*, of the radial recurrent, and with a branch, *h*, of the recurrent interosseous ; and the third artery, *k*, descends in the triceps to the hollow between the outer condyle and the olecranon, and entering the anconeus, G, joins in it with the recurrent of the interosseous.

The *cutaneous offsets*, two or three in number, pass out with the nerves to the integuments, and are derived, for the most part, from the branch, *f*.

The *posterior circumflex artery* enters under the deltoid muscle (Plate v.). From the part of the artery now visible spring the branch to the teres minor, *l*, and the offsets to the integuments and the deltoid, *m*, and *n*.

The usual *companion veins* run with the arteries, though they are not included in the Plate ; those with the profunda artery join a brachial vein ; and the circumflex veins open into the axillary trunk.

NERVES OF THE BACK OF THE ARM.

The nerves correspond in the main with the vessels. With the profunda is situate the large musculo-spiral nerve, distributing branches to the triceps and the integuments ; and by the side of

the circumflex artery is the muscular nerve of the same name, which ends in the deltoid.

1. Musculo-spiral nerve.
2, 2. Ulnar nerve.
3. Offset to the long head of the triceps.
4. Offset to the inner head of the triceps.
†††. Three branches to the outer head of the triceps.
6. Branch to the anconeus.
7. Upper external cutaneous of the musculo-spiral.
8. Lower external cutaneous of the musculo-spiral.
9. Nerve to the teres minor.
10. Cutaneous branch of the circumflex nerve.

The *musculo-spiral nerve*, 1, begins in the brachial plexus (Plate i. 13), and, reaching the digits, supplies the extensor and supinator muscles on the back of the arm and forearm, together with some of the integuments.

In the arm the trunk winds behind the humerus from the inner to the outer side, and divides at the outer condyle into two—radial and posterior interosseous nerves (Plate xii.). The nerve lies in the groove of the humerus between the inner and outer heads of the triceps, and turns to the front of the arm above the supinator longus muscle, H. Offsets of the part of the nerve now dissected supply the extensors of the elbow-joint and the teguments.

Muscular branches enter the heads of the triceps. One, 3, belongs to the parts, A, and B, of the long head; others, 4, and 6, supply the inner head, D; and three † † † enter the outer head, C. To the inner and middle heads some branches are furnished by the trunk of the nerve in the axilla (Plate iv. 2).

The branch, 6, of the anconeus is very slender, and is contained in the triceps.

Cutaneous nerves.—Two external cutaneous appear with superficial arteries on the outside of the limb; the upper one, 7, smaller than the other, reaches in the integuments of the arm as far as the elbow; and the lower nerve, 8, is continued beyond the elbow, on the back of the forearm, nearly to the wrist.

Whilst the musculo-spiral is contained in the axilla it furnishes an internal cutaneous nerve to the inner and hinder parts of the arm (Plate iv. 1).

If the musculo-spiral nerve is cut across, or its action much im-

paired by disease, the extensor muscles of the elbow-joint, amongst others, would be incapable of contracting; and the elbow would therefore be bent by the flexors which, being uncontrolled by their antagonists, would carry forwards the forearm bones.

Ulnar nerve, 2, 2.—The upper and lower parts of this nerve come into view in the dissection. The whole course of the nerve appears in Plate iv.

Circumflex nerve of the shoulder.—The trunk of the nerve is noticed in the description of Plate v. Two offsets, viz., one marked, 9, for the teres muscle, and another, 10, for the integuments, appear behind the deltoid muscle.

DESCRIPTION OF PLATE VIII.

THE dissection of the muscles, vessels, and nerves of the front of the forearm, with their connections undisturbed, which follows after reflecting the deep fascia.

All the superficial coverings of the limb may be removed at once by an incision along the front of the forearm, met by a cross-cut a little above the elbow, and by another rather below the wrist. But a more profitable dissection may be made by examining and afterwards removing in successive layers, the skin, the subcutaneous fat with its vessels and nerves, and the deep fascia.

SUPERFICIAL MUSCLES OF THE FOREARM.

Inside the line of the brachial and radial arteries, *b* and *f*, lies a group of muscles which act as flexors and pronators; and outside the vessels is a mass of muscles consisting of extensors and supinators, antagonists of the former set.

The inner group is divided into two strata, superficial and deep. Five muscles belong to the superficial layer: of these one is a

pronator of the hand, and the others are flexors of the wrist and fingers.

A. Biceps flexor brachii.
B. Brachialis anticus.
C. Pronator teres.
D. Palmaris longus.
E. Flexor carpi radialis.
F. Flexor digitorum sublimis.
G. Flexor carpi ulnaris.
H. Flexor longus pollicis.
L. Supinator longus.
N. Palmaris brevis.
P. Extensor carpi radialis longior.
S. Extensor ossis metacarpi pollicis; close alongside is the tendon of the extensor primi internodii pollicis.
† Inner intermuscular septum of the arm.
* Slip of fascia connecting the tendon of the flexor carpi ulnaris with the annular ligament.

Pronator radii teres, C, the first muscle of the inner group, arises in part from the common origin;* also from the condyloid ridge of the humerus, and from the coronoid process of the ulna by a separate slip (Plate ix.). Below it is inserted into the middle of the radius beneath the supinator longus, L.

By its outer edge the muscle bounds the hollow in front of the elbow, and by the other it touches the flexor carpi radialis. Near the insertion the radial vessels rest on it.

When the pronator first contracts it will roll the radius over the ulna, pronating the hand; and acting still farther, it will bend the elbow-joint over which it passes.

The *flexor carpi radialis*, E, having the common origin, is continued through a groove in the trapezium bone to be inserted chiefly into the base of the metacarpal bone of the index finger, but also by a slip into the metacarpal bone of the middle finger.

The tendon of the muscle is prominent below outside the middle line of the forearm, and bounds internally a depression over the radius containing the radial artery; it may be taken as the guide to that vessel.

After bending the wrist, the muscle will approximate the forearm to the arm.

* Most of the superficial muscles of the forearm, on both the front and back, have a common origin from the fascia of the limb, and from a strong fibrous process (tendon of origin) which is attached in each case to the condyle of the humerus, and sends pieces between the muscles.

The *palmaris longus*, D, has the common origin between the preceding and the flexor carpi ulnaris, G; and its tendon piercing the aponeurosis of the limb near the wrist, ends in the fascia of the palm of the hand, after sending a slip to join the short muscles of the thumb. This muscle may be absent.

It renders tense the palmar fascia, and assists in bending the elbow and wrist.

The *flexor carpi ulnaris*, G, is the most internal muscle of the set. Attached to the inner condyle of the humerus, where it blends with the other muscles; and by an aponeurosis to the posterior ridge of the ulna; it is inserted into the pisiform bone, and joins by offsets the annular ligament of the wrist and the muscles of the little finger.

The outer edge of the muscle corresponds with a line from the pisiform bone to the inner condyle of the humerus, and there is a surface-groove in the lower third of the forearm over that edge. The muscle conceals below the ulnar vessels and nerve.

Its main action is expressed by its name, but it serves also as a flexor of the elbow-joint.

The *flexor digitorum sublimis*, F, is the deepest of the muscles of the superficial layer. It is attached by its thin outer edge to three-fourths of the shaft of the radius; higher up, to the inner side of the coronoid process of the ulna; and finally to the lateral ligament of the elbow-joint and the common tendon of origin of the other muscles. It ends below in four tendons for the fingers, which cross the hand, and are inserted into the middle phalanges (Plate x.).

The extent of attachment to the radius, and the position of the radial vessels to it may be noticed in the drawing. Only two tendons appear on the surface, viz., those of the middle and ring fingers. Issuing beneath the lower border is the median nerve, 2.

Besides bending the phalanges, the muscle will contribute to flex the wrist and elbow.

Above the elbow are the flexors of that joint, viz., *biceps* and *brachialis anticus*. The first is inserted into the radius and the

other into the ulna ; and when they contract they carry forwards those bones over the end of the humerus.

After fracture of the olecranon process of the ulna—the part limiting the movements and giving security to the joint, the elbow is bent because these two muscles are stronger than the extensor muscles behind (the triceps being useless).

In dislocation of the humerus on the front of the ulna and radius, the flexor muscles give the bent state to the limb. Being greatly stretched, especially the brachialis, by the large projecting end of the humerus, they contract powerfully ; and the forearm is carried forwards as much as it can be to relax the tense state of the muscular fibres.

The extensors and supinators on the outer side of the limb are dissected only in part : they will be described more fully with Plate xii. They are divisible, like the muscles in front, into a superficial and a deep layer. Only one of them will be referred to now.

The *supinator longus*, L, (brachio-radialis Sœm.) is the most anterior and the longest of the external group. It arises from the upper two-thirds of the condyloid ridge of the humerus in front of the outer intermuscular septum (Plate xii.); and it is inserted into the lower end of the radius, close to the styloid process.

Covered at its origin and insertion by other muscles, it forms part of the outer swell of the forearm, and limits externally the hollow in front of the elbow-joint. It rests upon the long radial extensor of the wrist, P, and covers the radial artery in the upper half of the forearm. At its insertion it is crossed by the extensor muscles of the thumb, S.

Its chief office is to bend the elbow-joint. But it will become a supinator when the hand is prone ; and, when the hand is strongly supinated, it is said to bring the same into the prone state.

HOLLOW IN FRONT OF THE ELBOW.

This intermuscular space between the inner and outer groups of

muscles is represented by the ham in the lower limb. It contains the chief vessel of the arm and the companion nerve ; and by its position on the aspect of the limb to which the joint is bent greater freedom of movement forwards is permitted.

The interval is somewhat triangular in form, as seen on the surface, and has the following boundaries :—stretching over it is the aponeurosis of the limb joined by an offset from the biceps tendon, with the integuments and the superficial veins and nerves (Plate iii.) ; and covering the underlying bones are the brachialis anticus, B, and supinator brevis. Externally is placed the supinator longus, L, and internally the pronator teres, C ; the fibres of the former being nearly straight in the forearm, and those of the latter slanting downwards and outwards. The base is turned towards the arm ; and the apex points forwards in the forearm.

Contained in the hollow is the tendon of the biceps, with vessels, nerves, fat, and lymphatics ; and their position in it is as follows :—

On the outer side is the biceps muscle, A, whose tendon dips into the space to reach its insertion into the radius.

The brachial artery, *b*, lies close inside the biceps, and divides, opposite the "neck of the radius," into the two arteries of the forearm, which are directed forwards through the space, the radial being superficial and the ulnar deep in its position. Venæ comites entwine around the arterial trunks. Small arteries are found in the space. Thus in the outer part the recurrent of the radial artery (Plate xii. 3) is directed transversely to the supinator longus ; and in the inner part of the hollow offsets of the anastomotic artery, *a*, descend beneath the pronator teres to join the anterior recurrent of the ulnar artery. Other cutaneous offsets, *c* and *d*, come forwards to the integuments from the brachial and the radial artery.

Inside the artery, and separated from it by a slight interval which increases below to a quarter or half an inch, comes the median nerve, 2. At this spot the nerve supplies small offsets to the inner group of muscles of the forearm. Underneath the supinator longus, and therefore outside the superficial limits of

the space, the musculo-spiral nerve may be found dividing in front of the condyle of the humerus into radial and posterior interosseous branches.

Loose fat fills the hollow, supporting the vessels and nerves, and extends into the forearm along the bloodvessels; and blood beneath the fascia finds its way along the same channels.

A few lymphatic glands with their connecting vessels accompany the arteries—two or three lying on the sides of the brachial, and one below its point of splitting.

From the lax condition of the parts surrounding the brachial artery pressure applied to the vessel when wounded, should be firm and graduated. The limb too should be kept still; for when the elbow is moved much the vessel may slip away from the compressing pad, and blood may be effused beneath the fascia.

ARTERIES OF THE FOREARM.

Two chief vessels occupy the front of the forearm, and these spring from the division of the brachial trunk. They are named radial and ulnar from their position in the limb; and both reach the palm of the hand, where they form arches and supply branches to the fingers. Both are placed deeper near the elbow than at the wrist.

a. Anastomotic branch of the brachial trunk.
b. End of the brachial artery.
c, *d*. Unnamed cutaneous offsets: the former from the brachial, and the latter from the radial artery.
f. Radial artery.
g. Superficial volar branch.
h. Ulnar artery.
n. Cutaneous median vein, joining a deep companion vein.

The *radial artery*, *f*, is the more external of the two bloodvessels in the forearm, and inclines from the bifurcation of the brachial trunk to the lower end of the radius; it then winds to the back of the wrist below the radius, and enters the hand. The part from the wrist onwards will be included in other dissections (Plates x. and xi.). A line from the centre of the elbow-joint

to the styloid process of the radius will mark the course of the vessel on the front of the forearm.

In the *upper half* of the forearm the artery is concealed by the supinator longus ;* and it rests in succession on the supinator brevis, pronator teres, C, and flexor sublimis digitorum, F.

Venæ comites lie on the sides of the artery. But no nerve is in contact with it—the radial being placed too far out.

This part of the artery may be superficial to the long supinator, lying even in the integuments when there is an unusual origin from the brachial.

In the *lower half* of the forearm the vessel is not covered by muscle, but is contained in a hollow between the tendons of the flexor carpi radialis, E, and supinator longus, L. Only the common teguments cover the vessel here. It is supported by part of the flexor sublimis, F, flexor longus pollicis, H, and lower down by the pronator quadratus and the end of the radius.

The usual veins surround the artery. The radial nerve, 3, is at some little distance outside the vessel, and becomes cutaneous behind the tendon of the supinator longus.

The *offsets* of the radial artery are for the most part small, but near the elbow and wrist they acquire greater size. No one is large enough usually to interfere with the placing a ligature on the trunk.

Ligature of the radial artery.—In the upper half the vessel would not require to be tied in the living body unless it was wounded. In seeking it amongst the tissues infiltrated with blood the supinator longus, and the line of the vessel, will serve as material aids to the surgeon.

In the lower third of the forearm, the radial may be secured for a wound in the palm of the hand. With a cut about one inch and a half long the integuments and superficial veins and nerves are to be divided in the line of the vessel. The fascia may be

* In Anatomical Plates the radial artery is usually delineated with the supinator longus removed from it, as if the vessel was uncovered by muscle in the upper half of the forearm. In this Plate the muscle is shown covering the artery, as it exists before it is displaced, to impress upon the memory the fact that where the radial is so protected it cannot be easily reached.

carefully cut for the same extent. After the sheath has been opened and separated from its contents in the usual way, the aneurism needle may be carried round the artery.

As this part of the radial is so superficial the student, when first practising the operation, cuts oftentimes, not only the coverings of the limb, but also the artery.

If the vessel is tied for a wound near the wrist two ligatures should be applied, although the size is so small, on account of the free communication of the radial with the ulnar artery in the palm of the hand.

Branches of the artery.—Small unnamed muscular and cutaneous offsets leave the trunk of the artery at intervals; and larger named branches arise near the beginning and ending.

The *recurrent radial* ascends under cover of the supinator longus, and anastomoses on the outer part of the elbow with the superior profunda (Plate xii.): it supplies some of the outer group of muscles.

The *superficial volar branch*, *g*, descends to the hand across or through the short muscles of the thumb. When small, it ends in those muscles; and when larger, it joins the superficial palmar arch (Plate x.). With this vessel of very unusual size a wound of it might require to be tied.

The *anterior carpal branch* (Plate ix. *d*), which is generally so small as not to deserve notice, arises near the wrist, and is lost on the carpus.

Muscular and cutaneous branches arise at tolerably regular intervals. One to the integuments is marked by *c*. From a muscular branch near the wrist a twig entered the median nerve.

The *ulnar artery*, *h*, is concealed almost entirely by muscles whilst it is in the forearm, only a small part near the wrist being visible before the natural position of the flexor carpi ulnaris has been disturbed.* And the part of the artery, which is repre-

* In Plates of the vessels of the forearm, where the ulnar artery is laid bare to view in the lower third or more, the flexor carpi ulnaris has been drawn aside in the dissection. This rather deep condition of the artery should be kept in mind in any attempt to put a ligature on it.

sented, appears smaller than it is commonly, in consequence of being partly covered by the venæ comites. The course and the branches of the artery are shown in Plate ix.

NERVES OF THE FOREARM.

Three nerves, viz., median, ulnar, and radial, are visible for a short distance in this dissection of the superficial muscles of the forearm.

1. Cutaneous part of the musculo-cutaneous, named external cutaneous of the forearm.
2, 2. Median nerve.
3. Radial nerve.
4. Cutaneous palmar branch of the median nerve.
5. Palmar part of the ulnar nerve.

The *median nerve*, 2, is superficial for two inches above the wrist, and is placed on the outer side of the tendons of the flexor sublimis. As it passes through the forearm it lies beneath the superficial flexors. From the forearm it is continued to the hand beneath the annular ligament. The following offset arises from this part of the nerve.

The *cutaneous palmar branch*, 4, pierces the deep fascia near the wrist, and crosses over the annular ligament to end in the integuments of the ball of the thumb and palm of the hand; at its ending it communicates with the ulnar nerve.

The *radial nerve*, 3, is a tegumentary branch of the musculo-spiral (Plate xii. 2), and ends on the back of the hand. Becoming superficial behind the tendon of the supinator longus, it terminates in the teguments of the back of the thumb, of the next two digits, and sometimes of half the ring finger.

The *ulnar nerve*, 5, enters the palm of the hand over the annular ligament; its termination is given in Plate x. This is the only part of the nerve laid bare before the flexor carpi ulnaris has been turned aside; and this is partly concealed by the ulnar vessels.

DESCRIPTION OF PLATE IX.

THIS Plate represents the dissection of the deep muscles on the front of the forearm, with the vessels and nerves in contact with them.

To make ready the dissection cut through near the humerus and remove the inner group of the superficial muscles, seen in Plate viii., except the pronator teres on the outside, and the flexor carpi ulnaris on the inside; then draw upwards the pronator, and inwards slightly the last muscle from the ulnar vessels. The small veins with the branches of the arteries have been taken away.

DEEP MUSCLES OF THE FOREARM.

The deep muscles are three in number: two flex the digits, and one pronates the radius. One a flexor of the thumb, lies on the radius; and the other large muscle covering the ulna, is the common flexor of the fingers. The pronator is placed beneath the other two near the wrist.

A. Lower end of the biceps.
B. Brachialis anticus.
C. Supinator longus.
D. Pronator teres.
F. Conjoined palmaris longus and flexor carpi radialis cut, and turned aside.
G. Flexor carpi ulnaris.
H. Supinator brevis.
J. Cut end of the flexor sublimis.
K. Flexor longus pollicis.
L. Flexor profundus digitorum.
N. Slip of flexor longus pollicis.
O. Extensor ossis metacarpi pollicis.
P. Pronator quadratus muscle.
Q. Tendons of flexor sublimis cut.
R. Tendon of flexor carpi radialis.
X. Anterior annular ligament.
† Internal intermuscular septum of the arm.

The *flexor longus pollicis*, K, arises from the upper three-fourths of the anterior surface of the shaft of the radius; from the con-

sented, appears smaller than it is commonly, in consequence of being partly covered by the venæ comites. The course and the branches of the artery are shown in Plate ix.

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F. Conjoined palmaris longus and flexor carpi radialis cut, and turned aside.
G. Flexor carpi ulnaris.
H. Supinator brevis.
J. Cut end of the flexor sublimis.
K. Flexor longus pollicis.
L. Flexor profundus digitorum.
N. Slip of flexor longus pollicis.
O. Extensor ossis metacarpi pollicis.
P. Pronator quadratus muscle.
Q. Tendons of flexor sublimis cut.
R. Tendon of flexor carpi radialis.
X. Anterior annular ligament.
† Internal intermuscular septum of the arm.

The *flexor longus pollicis*, K, arises from the upper three-fourths of the anterior surface of the shaft of the radius; from the con-

tiguous interosseous membrane ; and sometimes by a round slip, N, from the inner part of the coronoid process of the ulna. Its tendon passes beneath the annular ligament, X, and is conveyed along the thumb by a fibrous sheath to be inserted into the last phalanx.

Most of the muscle is covered by the flexor sublimis, but part of it below is in contact with the radial artery where the pulse is felt. Between the upper attachment of this muscle and the supinator brevis, H, is a narrow slip of bone from which the flexor sublimis digitorum arises.

The muscle bends the phalanges of the thumb, and brings the metacarpal bone towards the palm of the hand. It will flex the wrist after the digit.

Flexor profundus digitorum, L (perforans). It arises from the anterior and inner surfaces of the shaft of the ulna as low as the pronator quadratus ; and other fibres spring from the membranes outside and inside the bony attachment, viz., from the interosseous membrane externally, and from an aponeurosis common to this muscle and the flexor carpi ulnaris internally. The fleshy fibres end in tendons which are united together above the wrist, only the most external being separate ; and these, passing beneath the annular ligament, X, and across the hand, are inserted into the last phalanges of the fingers. See Plate x.

On the sides of the muscle are the flexor longus pollicis, K, and flexor carpi ulnaris, G. On it rest the ulnar vessels, and the ulnar and median nerves.

This muscle bends the last phalanx of each finger, and continuing its action it will aid in flexing the other phalanges and the wrist.

The *pronator quadratus*, P, lies beneath the preceding, and covers the lower ends of the bones of the forearm for about two inches, though more of the ulna than of the radius. Scarcely any part of the muscle is seen, but the interosseous nerve and artery pass beneath its upper edge, marking its extent upwards.

It is covered by the other two muscles of the deep layer, and the radial vessels touch the outer edge, near the wrist.

It acts on the radius, moving the lower end round the ulna so as to put down the palm of the hand.

Movement of the radius.—The rotatory motion of the hand is due to the movement forwards and backwards of the lower end of the radius over the ulna. When that bone is brought forwards the palm of the hand is placed down, or the limb is pronated; and when the bone is moved back the dorsum of the hand is turned towards the ground, and the member is supinated. The pronator muscles are in front, and passing from the inner side of the limb draw forwards the radius; while the supinators which turn back the bone are placed on both the front and hinder part of the limb. The action of the supinators will be given with the description of Plate xii.

Two pronators are connected with the radius;—one, pronator teres of the superficial layer, being attached about midway between the ends; and the other, pronator quadratus, of the deep layer, is fixed into the lower part. Both are therefore inserted below the upper half of the bone; and during their contraction the lower end of the radius is moved over the ulna—the upper end not changing its position to that bone, but rotating like a wheel in a sling. And as the active supinators (supinator brevis and biceps) are fixed to the upper part of the radius, their influence on the lower end is neutralised as soon as the bone is broken through at or near the middle; and so the lower fragment can be moved forwards without obstacle by the action of the pronators.

Fracture of the radius near or below the middle is attended by pronation of the hand, and by displacement of the lower fragment, in consequence of the action of one or both of the pronators, and of the weight of the hand articulated to the radius. But the upper fragment of the broken bone does not change its place; it remains on the outer side of the ulna, though tilted away from that bone by the action of the supinators. Readjustment of the displaced lower fragment will be made by supinating the hand, as this movement carries back at the same time the lower end of the broken radius into contact with the upper. Future displacement of the lower fragment will be prevented if the

weight of the hand is taken off by fixing the forearm and hand with splints in a position midway between pronation and supination, so that the thumb shall be in a line with the upper part of the radius, and the palm of the hand shall be turned to the chest.

Should the lower fragment not be brought well into line with the upper by the position of the forearm above-said, it will be necessary to place the hand quite supine (the palm of the hand looking directly upwards), and to fix it with splints in that posture, as was recommended by Mr. Lonsdale.*

In *fracture of the shafts of both bones* of the forearm, the lower ends, as in fracture of the radius, depart from the line of the upper ends, being dragged away by the weight of the hand. They have further a tendency to approximate across the interosseous space, and will therefore be easily made to touch by any constriction, such as a bandage round the limb.

By supinating the hand in the manner described for fracture of the radius, the lower displaced ends will be brought to the upper fixed parts of the bones. And with the view of keeping apart the bones, gentle pressure with a narrow graduated pad is sometimes employed along the front and back of the forearm in a line with the interval between the fixed upper extremities. Pressure by means of a bandage is not to be made on the member, lest the broken ends be approximated by it, and the movements of the radius be lost by this bone blending with the ulna in the process of union. Redisplacement of the apposited ends may be prevented by splints reaching from the elbow to the fingers.

ARTERIES OF THE FOREARM.

Both radial and ulnar arteries are laid bare in the dissection, but the anatomy only of the ulnar and its branches will be now given. For a short distance above the elbow-joint the brachial trunk is shown.

* "Fracture of the Forearm." By Edward Lonsdale. *Medical Gazette*, 1832, p. 910.

a. Brachial artery.
b. Radial artery.
c. Ulnar artery.
d. Anterior carpal branch of the radial trunk.
e. Superficial volar branch.
g. Posterior ulnar recurrent branch.
k. Anterior interosseous.
n. Median artery.

The *ulnar artery*, *c*, tends to the inner side of the limb, and enters the palm of the hand in front (Plate x.). It keeps the name ulnar from the bifurcation of the brachial trunk to the lower border of the annular ligament, X.

The artery has a curved course in the forearm. At its upper part it is directed inwards, but at the lower part it is straight. A line on the surface, to mark the straight part of the artery, should be drawn from the inner condyle of the humerus to the inner side of the pisiform bone. It is covered by muscles in the upper half of the forearm, but becomes more superficial below.

In the *deep part* of its course, viz., between the origin and the meeting with the flexor carpi ulnaris, G, the vessel is curved with the convexity upwards. It is covered by the superficial layer of muscles except the flexor carpi ulnaris; and it rests firstly on the lower part of the brachialis anticus, B, and afterwards on the flexor profundus digitorum, L.

Companion veins are ranged on its sides, with communicating branches over the artery.

The median nerve, 1, is placed inside the ulnar artery for about an inch; it then crosses over, and leaves that vessel in the forearm. The ulnar nerve, 3, approaches the artery about half way between the wrist and elbow-joints, from which point it is situate inside, and close to the vessel.

The *lower half* of the artery lies along the flexor carpi ulnaris, G, by which it is overlapped (Plate viii.); and it is therefore more deeply placed than the corresponding part of the radial vessel. On its outer side are the tendons of the flexor sublimis digitorum, F (Plate viii.), and it lies on the flexor digitorum profundus, L.

The companion veins join together freely over the artery, and the ulnar nerve, 3, is in contact with it on the inner side.

Filaments of the palmar cutaneous branch, 6, of the ulnar nerve entwine around the vessel.

As the artery rests on the annular ligament of the wrist, it is very near the pisiform bone ; it is crossed by a slip from the flexor carpi ulnaris to the annular ligament, and is concealed by some fleshy bundles of the palmaris brevis muscle (Plate viii.). The nerve, still internal, intervenes between the bone and the artery.

All the offsets of this lower part are too small to be considered of moment in ligature of the artery.

Ligature of the artery at its lower fourth, which is sometimes practised for a wound of the trunk in the palm of the hand, is a simple operation; and an inspection of Plate viii. will render more intelligible the following remarks.

Drawing back the inner part of the hand so as to stretch and depress the tendon of the flexor carpi ulnaris, make a cut about two inches long in the hollow observable on the surface, and carry it through the integuments and the deep fascia down to the flexor tendon. By bending the wrist, the tendon will be relaxed, and can be moved aside. Under the muscle but covered by a deeper layer of fascia, which is to be divided, the vessels and nerve will appear—the nerve being internal and serving as the deep guide to the artery.

When the sheath has been opened, and the artery detached from it and the surrounding veins, the needle carrying the ligature can be passed easily under the vessel.

In tying the vessel for a wound near the wrist two ligatures are to be used, as in the radial artery, because blood may be poured out above and below.

Branches.—Named offsets arise near the large joints of the wrist and elbow, and smaller muscular branches leave the trunk at short intervals.

The *posterior recurrent branch*, *g*, is continued beneath the superficial layer of muscles to the space between the inner condyle of the humerus and the olecranon process, where it supplies the joint, and communicates with the inferior profunda and anastomotic branches (Plate iv.).

Near its beginning, a small branch, *anterior ulnar recurrent*, ascends under the pronator teres to join the anastomotic branch.

The *interosseous artery* arises near the preceding, and divides into two, anterior and posterior, for the front and back of the limb. The posterior is seen in Plate xii.

The *anterior interosseous*, *k*, runs on the interosseous membrane between the two deep flexors as far as the pronator quadratus, P, where it passes through the membrane to end on the back of the wrist (Plate xii.): as the artery leaves the front of the limb it sends a branch on the interosseous membrane to the front of the wrist.

It supplies branches to the deep muscles. Another offset *median*, *n*, supplies the median nerve and the flexor sublimis muscle: sometimes this last branch is large, and is continued with the nerve to join the palmar arch in the hand.

A *metacarpal branch* proceeds along the inner edge of the metacarpal bone of the little finger, on which it ends.

A small *anterior carpal branch* takes origin opposite the lower edge of the pronator quadratus: it joins the corresponding branch of the radial artery.

Some *cutaneous offsets* pass forwards to the integuments at the outer edge of the flexor carpi ulnaris: three of these may be observed in Plate viii.

NERVES OF THE FOREARM.

The median and ulnar nerves supply the muscles on the front of the forearm, whilst the integuments receive nerves mostly from other trunks. The two have a marked difference in position when entering and leaving the forearm: thus above, the median is superficial in front of, and the ulnar is behind the elbow; but below, the median is deeply placed beneath the annular ligament, whilst the ulnar passes over the ligament.

1. Trunk of the median nerve.
2. Anterior interosseous branch.
3. Ulnar nerve.
4. Branches of ulnar nerve to flexor carpi ulnaris muscle.
5. Branch of ulnar nerve to flexor digitorum profundus.
6. Cutaneous palmar branch of the ulnar.
7. Palmar cutaneous nerve of the median.

The *median nerve*, 1, courses between the superficial and deep layers of muscles, till about two inches above the wrist where it approaches the surface (Plate viii.). It distributes nerves to all the superficial muscles except the flexor carpi ulnaris, and offsets of its interosseous branch supply the deep muscles.

Muscular offsets may be seen entering the pronator teres, D, the palmaris longus and flexor carpi radialis, F, and the flexor sublimis, J.

The *anterior interosseous branch*, 2, runs on the front of the interosseous membrane, with the artery of the same name, between or in the fibres of the flexors of the digits, and ends below in the pronator quadratus, P. It supplies the outer half of the flexor digitorum profundus, and the whole of each of the other two muscles, viz., flexor pollicis, and pronator quadratus.

The *cutaneous palmar branch*, 7, arises near the wrist: it is described with Plate viii.

The *ulnar nerve*, 3, is directed through the forearm along the flexor carpi ulnaris muscle, in the position of a line from the inner condyle of the humerus to the pisiform bone. Branches are supplied to one muscle and a half.

Articular filaments.—Behind the elbow one or two slender twigs are furnished to the joint.

Muscular offsets.—One or two nerves, 4, enter the flexor carpi ulnaris; and one, 5, belongs to the inner half of the flexor digitorum profundus.

The *palmar cutaneous branch*, 6, is conveyed along the lower half or third of the ulnar artery to the integuments of the palm of the hand: it sends offsets around the artery, and joins the palmar branch of the median nerve at its ending.

DESCRIPTION OF PLATE X.

VIEWS of the two dissections of the palm of the hand, which are needed to lay bare the superficial and deep muscles, vessels, and nerves.

FIGURE I.

In the left-hand figure the superficial palmar arch of the ulnar artery, with its offsets, the nerves to the digits, and the tendons of the flexor muscles are delineated.

In making the dissection the integuments and the deep palmar fascia are first to be removed. The former may be raised by a cut along the centre of the palm, terminated by cross cuts at the wrist and the roots of the fingers; and as the inner flap is raised, the palmaris brevis muscle will be met with in the fat. After the palmar fascia has been denuded, and its arrangement at the fingers examined, it may be cut behind, where it joins the tendon of the palmaris longus, E; and it is then to be thrown forwards.

By taking away the teguments of one finger, say the middle, the sheaths of the flexor tendons will come into view; and after the removal of the sheath, the arrangement of the tendons will be manifest, as in the ring finger.

CENTRAL MUSCLES OF THE PALM.

In the hollow of the hand lie the flexor tendons, with some other muscles. Laterally the muscles of the thumb and little finger form on each side a ball or prominence, to be noticed afterwards; and the group on the inner side is partly covered by the small subcutaneous palmar muscle.

A. Palmaris brevis.
B. Abductor pollicis.
D. Flexor brevis pollicis (outer head).
E. Tendon of palmaris longus.
G. Adductor minimi digiti.
H. Adductor pollicis.
J. Abductor minimi digiti.
K. K. Pieces of the sheath of the flexor tendons.
L. Part of the palmar fascia.
N. First dorsal interosseous muscle.
O. O. Two outer lumbricales.
R. Tendons of the flexor digitorum sublimis.
S. Tendon of flexor carpi ulnaris.
V. Flexor sublimis tendons in the palm of the hand.
W. Tendon of flexor profundus to the ring finger.
X. Anterior annular ligament.

Palmaris brevis, A.—This small subcutaneous muscle is unattached to bone. Consisting of fleshy bundles, more or less separate, which are attached to the palmar fascia, L, it is inserted into the skin at the inner border of the hand, extending downwards a varying distance from the pisiform bone. Its insertion is marked by a surface depression.

When the muscle contracts it elevates the skin on the inner side of the hand, and increases slightly the depth of the palmar hollow.

The tendon of the *palmaris longus*, E, enters the hand over the annular ligament: from its outer side an offset is prolonged to the thumb muscles, whilst the main part ends in the palmar fascia.

Tendons of the flexor sublimis digitorum, V.—Four in number, they are directed through the palm over the deep flexor; and at the root of each finger one enters the sheath of the digit, K, with a tendon of the deep flexor. Near the front of the metacarpal phalanx each is slit for the passage of the deep flexor tendon, W; and it is inserted by two slips into the sides of the second phalanx, about half way along the bone.

This muscle brings the middle phalanges towards the palm, and bends thus the nearest phalangeal joints—the first stage in the movement of closing the fingers. As the fingers are approximated to the palm, the muscle raises the metacarpal phalanges by means of the digital sheaths binding it to the bones; and it acts finally as a flexor of the wrist-joint.

Tendons of the flexor profundus (Plate ix.), also four in number, cross the palm beneath the superficial flexor, and may be seen projecting slightly on the sides. Entering the digital sheaths, each is transmitted through the accompanying flexor sublimis tendon, as is shown on the ring finger, and passes onwards to be inserted by a single piece into the base of the last phalanx. Small rounded muscles, the lumbricales, are attached to these tendons in the palm (Fig. ii.).

Between each tendon of the deep flexor and the fore part of the middle phalanx is a thin membranous band (opposite W) uniting the two, which is called "ligamentum breve;" and intervening in like manner between each piece of the superficial flexor and the front of the metacarpal phalanx, is another "ligamentum breve," to fix this tendon to the underlying bone.

The deep flexor draws forward the last phalanges, and bends the last phalangeal joints. Still continuing to shorten, it assists the superficial flexor in bending the metacarpo-phalangeal joints in the act of shutting the fingers; and combined with the same muscle, it will flex the wrist when the digits are closed.

In amputating on the living body through the phalangeal articulations, some difficulty is experienced, when the joint is opened at the back, in entering the knife between the ends of the bones, owing to the flexor tendon drawing the distal against the nearer phalanx; and this difficulty is increased in the case of the last joint, in consequence of the smallness of the part held preventing sufficient force being employed to overcome the tendon. When the joint is opened at the front the impeding tendon has been previously cut, and the operation can be executed without hindrance to the passage of the knife.

Sheath of the flexor tendons, K.—In each finger this reaches from the palm of the hand to the last phalanx. It is constructed on the one side by the bones; and on the other by fibrous bands, which are thinnest opposite the joints: these thinner pieces have been removed in the dissection.

A synovial membrane lines each sheath, projecting into the palm of the hand, where it is closed; and long tapering folds (vincula vasculosa) are continued from it to the tendons: one of

these, connected with the deep flexor, is shown in the opened sheath of the ring finger. In the thumb and the little finger the synovial membrane of the sheath is continued upwards into a large synovial membrane which surrounds the tendons of both flexors beneath the annular ligament.

SUPERFICIAL ARTERIES OF THE HAND.

The arrangement of the superficial palmar arch and its offsets, which is described as the usual one, is figured here, but many hands were examined before this condition was found. The arteries to the thumb and the radial side of the fore finger will be described in the explanation of Fig. ii.

a. Ulnar artery in the forearm.
b. Radial artery in the forearm.
c. Superficial palmar arch.
d. Superficial volar branch.
f. Four digital branches of the superficial palmar arch.
g. Communicating artery from the palmar arch to the radial branch of the index finger.
h. Communicating branch to the deep arch from the digital artery of the little finger.

The *ulnar artery*, *a*, enters the hand over the annular ligament, and curving towards the ball of the thumb forms the superficial palmar arch: it supplies branches to the greater number of the digits.

The *superficial palmar arch*—the continuation of the ulnar artery—lies across the hollow of the hand, between the lower border of the annular ligament and the ball of the thumb. With its convexity towards the fingers, it reaches nearly as far forwards as a line across the palm, from the middle of the fold between the thumb and the fore finger. Diminishing in size, it ends externally by joining branches of the radial, viz., the superficial volar branch, *d*, pretty constantly, and occasionally the branch to the radial side of the forefinger (Fig. ii., *d*) by means of the small communicating branch, *g*.

At its inner end the arch is covered by the palmaris brevis muscle, A, and thence to the ball of the thumb, by the integuments and the palmar fascia: it rests on the tendons of the flexors of the digits, and on the ulnar and median nerves.

Companion veins lie on the sides of the artery. From the concavity of the arch spring small unnamed offsets; and from the convexity digital arteries proceed.

The *digital arteries*, four in number, and marked each with the letter *f*, supply three digits and a half. In their course to the digits the three outer lie over interosseous spaces, whilst the other is placed along the inner part of the palm; and at the cleft of the fingers they divide, except the most internal, into two for the contiguous sides of the digits. Coursing along the fingers they are united by a loop behind each phalangeal joint; and at the end of the finger they terminate in a loop which gives offsets to the tip, as is seen on the fourth digit.

The following communications take place between the digital arteries of the ulnar and the branches of the radial. At the inner side of the palm the branch *h*, which springs from the artery to the inner side of the little finger, joins either the deep arch or an interosseous branch; at the roots of the fingers the digital arteries anastomose with the interosseous branches of the deep arch; and at the tip of the fore finger the digital artery on the ulnar side inosculates with the arteria radialis indicis.

In the hand the large digital vessels and nerves lie over the intervals between the metacarpal bones; and in the fingers they occupy the sides. Incisions into the palm of the hand can be made therefore with least injury over the line of the metacarpal bones; and into a finger, along its centre.

Wounds of arteries in the palm of the hand are followed generally by copious bleeding, in consequence of the numerous communications between the chief vessels. In an injury of the superficial palmar arch, at *c*, for instance, blood will be furnished by the ulnar trunk, *a*. And though this source might be cut off by a ligature, the blood could be supplied by the radial artery to the other end of the arch, through the anastomosing branches, *d*, and *g*; or through the anastomoses above described of the digital with the interosseous arteries, and with the arteria radialis indicis. In such an arrangement of the vessels as that delineated in the Figure, the bleeding from the wound might be commanded by placing a ligature on each side of the orifice in

the artery; or, as is more commonly done, by stopping the currents in the radial and ulnar trunks by pressure above the wrist, and by applying a graduated compress to the seat of injury. If, when the orifice of the artery has not been secured by a thread, pressure has been found ineffectual in stopping the bleeding, ligature of the ulnar artery, or of this and the radial, would have to be performed in addition to a compress to the wound.

But there is an occasional condition of the vessels, which renders the arrest of the hæmorrhage difficult unless the artery is tied in the wound. For instance, a third artery, sometimes as large as either the radial or the ulnar, may join the middle or the outer part of the superficial palmar arch, so as to bring blood freely to the wound. And as this vessel (usually an offset of the anterior interosseous, but sometimes of the radial*) courses with the median nerve beneath the annular ligament, and generally beneath the muscles, pressure would not be productive of much benefit in stopping the current in it, and ligature of it would be scarcely practicable. Recurring bleeding with the existence of this state of the vessels would be quite uncontrollable by the auxiliary means which would arrest it when the ordinary arrangement existed.

As the state of the palmar wound is sometimes unfavourable to any attempt to place a ligature on the vessel there, and as surgeons have a reasonable disinclination to enlarge wounds of the palm to search for the bleeding orifice, ligature of the brachial trunk has been practised when the bleeding resists the usual means of stopping it. The following case, illustrative of the inefficacy of securing the main trunk of the limb at a distance from the wound when a large branch joins the arch directly, as in the condition supposed, is instructive.

"A young man wounded his palmar arch: secondary hæmorrhage took place several times; the radial and ulnar were tied, but the bleeding returned; an artery of some size, a "vas aberrans," was discovered beating in the middle of the forearm, close under the

* Examples of these conditions of the arteries, collected chiefly by Mr. Quain, are contained in the museum of University College, London.

skin; a ligature was put on the brachial in the middle of the arm, with the hope of getting above the origin of the abnormal branch; it (the unusual branch) continued however to pulsate after the ligature was tightened; the vas aberrans itself was therefore tied at once, close below the elbow, but notwithstanding all these precautions, hæmorrhage occurred on the following day as violent as ever; the wound (in the palm) was a second time enlarged, and fortunately the blood burst forth at the time of operation and the wounded artery was easily tied: the patient recovered rapidly."*

The result of ligature of the brachial in the above-cited case teaches, that tying the vessel in the wound of the palm, if such a step is possible, is to be preferred to a distant operation on the main artery of the limb, in those instances in which the surgeon suspects that a large unusual median artery joins the superficial palmar arch.

SUPERFICIAL NERVES OF THE HAND.

The median and ulnar nerves divide in the palm of the hand into large branches, which end on the digits as the nerves of touch. They give branches to the superficial muscles; and the ulnar nerve supplies also the deep muscles by means of a special offset.

1. Trunk of the median nerve.
2. First digital branch.
3. Second digital branch.
4. Third digital branch.
5. Fourth digital branch.
6. Fifth digital branch.
7. Communicating branch from the median to the ulnar.
8. Outer digital branch of the ulnar.
9. Inner digital branch of the ulnar.
10. Trunk of the ulnar nerve.

The *median nerve*, 1, is the larger of the two trunks distributed in the hand. Issuing from beneath the annular ligament, it is

* This case is reported by Mr. Cadge, in the part of Morton's Surgical Anatomy which was completed by him (London, 1850, p. 371). The artery named "vas aberrans," does not correspond with the arteries commonly so called; and it was probably the "median artery," which sometimes arises from the lower end of the brachial, and joins the palmar arch, as Plate 45 of Mr. Quain's work on the Surgical Anatomy of the Arteries illustrates.

consumed chiefly in five digital branches, which supply both sides of each of the three outer digits, and the outer side or half of the ring finger. Comparatively few branches are furnished to muscles.

The *digital branches* are continued through the palm of the hand, and along the sides of the digits to the extremity, where they end in a tuft of offsets for the supply of the ball and nail-pulp of the finger. To the skin of the palm and the surface of the digits they give many branches.

Two of them supply lumbrical muscles; thus the third nerve, 4, gives a branch to the most external lumbricalis; and the fourth nerve, 5, to the next following muscle.

Muscular branches.—Part of the fleshy ball of the thumb is supplied by the branch, 8; this is distributed to the muscles outside the long flexor tendon, viz., to the abductor pollicis, B, opponens pollicis, C, and the outer head of the short flexor, D.

If the median nerve was cut through close to the annular ligament, sensibility would be destroyed in the palmar surface of the hand and fingers outside a line drawn from the middle of the ring finger to the wrist; and it would be diminished at the dorsal aspect of the three outer digits beyond the metacarpo-phalangeal joints, where offsets from the anterior digital nerves ramify.

The muscles of the thumb before referred to as supplied by the median, and marked B, C, and D, together with the outer two lumbricales, would be paralysed.

The *ulnar nerve*, 10, divides on the annular ligament into a superficial or digital, and a deep or muscular part.

From the superficial part two *digital branches*, 8 and 9, are furnished to the little finger (both sides), and to half the ring finger; these have a similar distribution to the digital nerves of the median.

The branch marked 9 sends offsets to the palmaris brevis muscle, and the integuments of the inner part of the hand; and the external of the two, 8, receives a connecting branch, 7, from the median nerve.

Insensibility of the palmar surface of the hand and fingers, inside a line from the ring-finger to the wrist, follows incision of

the trunk of the ulnar nerve ; and the power of feeling would be lost at the same time on the back of the two inner fingers which are supplied by the same nerve. Besides the paralysis of the deep muscles attending injury of the nerve, to be specified in the description of Fig. ii., the small palmaris muscle, A, will lose its power of contracting.

FIGURE II.

Most of the special muscles of the hand, and the deep palmar arch, with its companion nerve, are represented in the right-hand figure of the Plate.

This dissection follows the preceding, and to carry it out the superficial palmar arch and the ulnar and median nerves are to be cut through at the annular ligament, and are to be taken away : then the superficial and deep flexor tendons having been cut at the same spot, are to be thrown forwards to the digits—the lumbrical muscles attached to the deep tendons being cleaned as the superficial tendons are raised.

SPECIAL MUSCLES OF THE HAND.

All the muscles which have both origin and insertion in the hand will be now described, with the exception of the palmaris brevis. They consist of three sets : a thumb group, a little-finger group, and a central group for the other digits.

B. Abductor pollicis.
C. Opponens pollicis.
D. Outer head of flexor brevis pollicis.
F. Inner head of flexor brevis.
H. Adductor pollicis.
J. Abductor minimi digiti.
K. Flexor brevis minimi digiti.
L. Adductor minimi digiti.
M. Tendon of the flexor longus pollicis.
N. First dorsal interosseous.
O. Lumbricales muscles.
P. Interossei of the hand.
R. Tendons of flexor digitorum sublimis.
S. Tendon of flexor carpi ulnaris.
T. Tendon of flexor carpi radialis.
V. Tendons of flexor profundus.

The *thumb muscles*, four in number, consist of an abductor, an adductor, and a flexor, with a special muscle to oppose the thumb to the other digits.

Abductor pollicis, B.—This is the most superficial muscle. It arises behind from the annular ligament, and the ridge of the trapezium bone ; and is inserted by a tendon into the outside of the base of the first phalanx.

The muscle draws away the thumb from the index finger.

Adductor pollicis, H.—The origin of the muscle, which is not always separate from the inner head of the flexor brevis, is fixed to the ridge on the palmar surface of the metacarpal bone of the middle finger ; and the muscle is inserted with the inner head, F, of the short flexor into the inner side of the base of the first phalanx.

By its action the thumb is placed on the palm and the fore finger, so as to deepen externally the hollow of the hand.

Opponens pollicis, C.—The muscle is partly covered by the abductor, and arises, like it, from the annular ligament and the prominence of the trapezium bone : it is inserted into the metacarpal bone of the thumb along the outer edge.

This muscle abducts the metacarpal bone, and so moves it as to allow the ball of the thumb to be turned opposite the ball of each digit, as in the act of picking up a pea with the thumb and a finger.

The *flexor brevis pollicis* is divided into two pieces or heads, D and F, at its insertion into the thumb. Single at its hinder attachment or origin, it is fixed to the annular ligament near the lower edge, to two carpal bones (os trapezoides and os magnum), and to the bases of the two metacarpal bones answering to the two carpals. The fibres, collected into two bundles which are separated by the tendon, M, of the long flexor, are inserted into the sesamoid bones, and the base of the first phalanx—the outer head, D, joining the abductor, and the inner head, F, blending with the adductor pollicis.

This muscle bends the metacarpo-phalangeal joint of the thumb ; it draws inwards also the thumb over the palm and approaches it to the other digits.

Little-finger muscles.—The group of muscles connected with the little finger contains three, viz., an abductor, an adductor, and a short flexor, as in the thumb ; but the flexor is sometimes absent.

Abductor minimi digiti, J, arises behind from the pisiform bone; and is inserted into the base of the first phalanx on the inside, sending an offset to join the extensor tendon.*

It draws the little from the ring finger, and assists in bending the metacarpo-phalangeal joint.

Adductor minimi digiti, vel opponens, L, arises posteriorly from the annular ligament, and the hook of the unciform bone; and it is inserted into the inner side of the fifth metacarpal bone.

The fibres shortening as they contract, would draw forwards the metacarpal bone, and deepen the hollow of the palm.

Flexor brevis minimi digiti, K, takes origin from the annular ligament and the unciform process, superficial to the preceding muscle; it is inserted with the abductor into the base of the first phalanx.

By its position in the hand this muscle is enabled to act as a flexor of the metacarpo-phalangeal joint.

In the *central group* of the hand are included superficial and deep muscles: the former, or the lumbricales, are attached to the deep flexor tendons; and the latter, the interossei, lie between the metacarpal bones.

The *lumbrical muscles*, four in number, and marked by the letter O, arise from the tendons of the flexor digitorum profundus, near the wrist. Placed on the radial side of the tendons, each joins, opposite the metacarpo-phalangeal joint, the extensor tendon on the back of the first phalanx. The two external muscles arise each from a single tendon, and the two internal from two tendons for each.

They flex the metacarpo-phalangeal joints by bringing forwards the first phalanges, and assist the special flexors in closing the fingers.

The *interossei muscles* occupy the inter-metacarpal spaces—two being present in each space except the first, in which there is only one: they are divided into two sets, palmar and dorsal.

The *dorsal set*, four in number, are shown in Plate xi. Each

* Lehre von den Muskeln, &c. Von Friedrich Wilhelm Theile. Leipzig, 1841, p. 283.

arises from the two bones bounding the metacarpal space, and is inserted into the base of the metacarpal phalanx, chiefly into the bone, though it joins also the extensor tendon by a fibrous process. The first or most external, which is sometimes called abductor indicis, is the largest : it is marked by N.

These muscles act as abductors of the fore and ring fingers from the middle one ; and they can move the last-mentioned digit to each side of a line passing lengthwise through it. The first may adduct the metacarpal bone of the thumb to that of the index finger.

The *palmar set*, only three in number, lie in the three inner spaces ; and the middle finger does not receive any of this set. Arising from the metacarpal bone of the finger to which each belongs, they are inserted, like the dorsal, into the nearest phalanx of their fingers ; each has but a slight attachment to the bone, blending most with the extensor tendon.*

When acting they bring together the separated fingers, and will draw the fingers, into which they are inserted, viz., the fore, ring, and little, towards the middle digit.

DEEP ARTERIES OF THE HAND.

The radial artery ends in the palm of the hand by forming an arch ; and it furnishes arteries to the digit and a half left unsupplied by the ulnar trunk. It enters likewise into numerous communications with offsets of the ulnar artery.

a. Deep palmar arch.
b. Profunda branch of the ulnar artery.
c. Large artery of the thumb.
d. Digital artery to the radial side of the fore finger.
e. Communicating branch to the deep arch from the digital artery to the little finger.
f, f. Two inner interosseous arteries.
h, h. Offsets to lumbrical muscles.

Radial artery.—Passing into the hand through the first interosseous space, it furnishes digital arteries to the thumb and the fore finger, and ends in the deep palmar arch.

* This difference in the insertion of the dorsal and palmar sets, is stated by Theile in the work on the muscles before quoted, p. 286.

The *digital artery of the thumb*, *c* (art. magna pollicis), courses along the metacarpal bone, and divides near the joint between this and the phalanx into two branches: these supply the sides of the thumb, and join at the tip in the usual way.

The *digital artery of the index finger*, *d* (art. radialis indicis), lies along the second metacarpal bone, and issuing from beneath the adductor pollicis, H, runs on the radial border of its digit to the extremity, where it anastomoses with the digital artery from the superficial arch. Sometimes it joins the superficial palmar arch through a branch, *g*, Fig. I.

The *deep palmar arch*, *a*, is the curve formed by the radial artery at its ending. It reaches from the first to the fourth interosseous space; it lies near the carpus, and is rather convex forwards, like the superficial arch. At the inner end it communicates with the profunda branch, *b*, of the ulnar, and with the branch, *e*, belonging to the digital artery to the inner side of the little finger. The arch has a deep position in the hand;—internally it is covered by the adductor minimi digiti, L; externally by the inner head of the flexor brevis pollicis, F; and between these, by the flexor tendons: it rests on the three middle metacarpal bones, and their intervening muscles.

Offsets of the arch.—From the concavity small offsets are directed back to the carpus. Three small *perforating arteries* pierce the three inner dorsal interosseous muscles to reach the back of the hand. Its chief branches are described below:—

Interosseous branches, *f*, *f*.—Only two of these now appear, and the other lies beneath the adductor pollicis: they extend to the clefts of the fingers, giving muscular twigs, and end by joining the digital arteries of the superficial arch.

Muscular branches, *h*, *h*, supply the two or three inner lumbrical muscles.

Through the communication of the radial with the ulnar artery, at the inner side of the hand, blood would find its way directly into the superficial palmar arch after ligature of the ulnar trunk above the wrist; and by means of the anastomoses between the branches of the two arteries (p. 89), blood would be conveyed from the superficial to the deep arch.

Wounds of the deep arch are rare, in consequence of its deeper and securer position in the hand; and ligature of the vessel would be oftentimes impossible. Supposing the wounded vessel cannot be reached, the bleeding would most probably be arrested by a graduated compress to the wound, and by pressure on the radial and ulnar arteries in the lower third of the forearm. If those means fail to stop the bursting forth of the blood, ligature of the radial artery—the chief vessel entering the arch—would probably be effectual in commanding the hæmorrhage. Should bleeding still occur, and possibly from large communicating branches with the ulnar artery, for no large unusual artery joins the deep arch, tying the ulnar trunk might be tried. As a last resource ligature of the brachial artery remains.

DEEP NERVE OF THE PALM.

The ulnar nerve is distributed to those muscles of the inner and deep parts of the palm, which do not receive branches from the median nerve.

1, 1. Branches to the lumbrical muscles.

2. Deep palmar branch of the ulnar nerve.
3. Trunk of the ulnar nerve.

The *deep palmar branch*, 2, of the ulnar nerve, arising near the wrist, passes deeply between the flexor brevis and abductor minimi digiti, or through the adductor muscle, L, as in the Figure, and accompanies the radial arch to the first interosseous space, where it ends by supplying the adductor pollicis, H, and the inner head, F, of the flexor brevis pollicis.

Muscular offsets are furnished to the muscles of the little finger, viz., abductor, J, flexor brevis, K, and adductor, L; to all the seven interossei muscles; and to the inner two lumbricales.

All the muscles of the hand, except two and a half of the thumb and the two outer lumbricales, receive branches from the deep part of the ulnar nerve. Destruction of the trunk of the ulnar nerve in the arm would affect the movements of the thumb

and fingers; but notably those of the little and ring fingers, whose short or hand muscles depend solely on the ulnar nerve for their contractile power.

DESCRIPTION OF PLATE XI.

THE dissection of the superficial muscles and vessels on the back of the forearm and hand is here illustrated.

This view was obtained by reflecting the integuments from the elbow to the roots of the fingers; and by removing the deep fascia, with the exception of the posterior annular ligament near the wrist. The fore finger was then denuded of its cutaneous coverings, to trace the extensor tendon to the end.

SUPERFICIAL MUSCLES.

At the back of the forearm are placed the muscles which oppose by their action the muscles in front; and as the anterior group consists of flexors and pronators, so the posterior includes their antagonists—extensors and supinators.

The posterior set is divided, like the anterior, into superficial and deep layers. In the superficial layer are contained one supinator, and the extensors of the wrist and digits, which are indicated below by the letters of reference.

A few of the deeper muscles appear near the wrist, but these will be described with Plate xii.

A. Biceps brachii muscle.
B. Supinator longus.
C. Extensor carpi radialis longior.
D. Extensor carpi radialis brevior.
E. Extensor digitorum communis.
F. Extensor minimi digiti.
G. Extensor carpi ulnaris.
H. Anconeus.
J. Brachialis anticus.
K. Extensor ossis metacarpi pollicis.
L. Extensor primi internodii pollicis.
N. Extensor secundi internodii pollicis.
O. Dorsal interosseous muscles.

P. Fibrous bands joining the extensor tendons near the knuckles.
R. Expansion from the extensor tendon opposite the finger joints.
S. Splitting of the extensor tendon.
T. Insertion of the extensor tendon into the last phalanx.
V. Tendon of the indicator muscle.
X. Posterior annular ligament.
† Deep fascia of the arm.

The *supinator longus*, B ("brachio-radialis," Sœm.), is the most external muscle ; it appears also in the anterior view of the forearm, with the description of which (Plate viii.) part of its anatomy has been given.

Arising, as before said, from the two upper thirds of the condyloid ridge of the humerus, and from the intermuscular septum, it is inserted into the radius close to the root of the styloid process.

Narrowed at the origin, it is widened below the elbow over the subjacent muscles forming the prominence of the outer part of the forearm. The anterior border touches the brachialis anticus, J, the biceps, A, and the pronator teres (Plate viii.) ; and the posterior edge is in contact with the extensor carpi radialis longior, C, and with the extensor carpi radialis brevior,* D. Near its insertion the tendon is covered by the extensors of the thumb.

This supinator acts mostly as a flexor of the elbow joint. If the hand is greatly pronated, the muscle can draw backwards the radius to a certain extent ; and if the hand is much supinated, the lower end of the radius will be moved somewhat forwards as in pronation ; in both cases the hand is brought into a state midway between pronation and supination (Theile).

* This projection backwards of the supinator so as to touch the extensor carpi radialis brevior is not referred to by anatomists of authority. It is not represented by Albinus in his standard work, Tabulæ Anatomicæ Musculorum Hominis. Lond. 1747 ; nor in the modern work of Bourgery and Jacob, Traité complet de l'Anatomie de l'Homme. Paris, 1833. Neither Theile, in his treatise on the muscles in Sœmmerring's Anatomy (Lehre von den Muskelm, &c. Leipzig, 1841) ; nor Henle, in his recent Handbuch der Systematischen Anatomie des Menschen, Dritte Abtheilung, Braunschweig, 1858, takes notice of the fact. Cruveilhier is silent also respecting this connection of the muscle in his systematic work, Traité d'Anatomie descriptive. Deuxième édition. Paris, 1843.

The *extensor carpi radialis longior*, C, arises from the lower third of the outer condyloid ridge of the humerus, and, below the elbow, from the intermuscular septum between it and the following extensor. In the lower part of the forearm its tendon passes through the posterior annular ligament with the shorter extensor, and is inserted into the base of the metacarpal bone of the index finger.

The muscle is superficial above and below, but it is covered by the supinator longus in the upper part of the forearm.

The *extensor carpi radialis brevior*, D, takes origin from the outer condyle of the humerus by the common tendon,* and from the capsule of the elbow joint. Beyond the annular ligament the tendon is inserted into the base of the metacarpal bone of the second finger.

This extensor is superficial in great part, but two muscles of the thumb, K and L, rest on it below. Along the outer edge lie the long radial extensor of the wrist, and the long supinator.

Both radial extensors draw backwards the hand, extending thus the wrist. The longer muscle can assist the supinator in bending the elbow; and the shorter one may help in straightening the elbow after the joint has been bent.

Extensor digitorum communis, E. Attached above by the common origin, it ends below in four tendons: these cross the back of the hand, and are inserted into the middle and ungual phalanges of the fingers.

On the hand the little finger tendon is often united in part with that of the ring finger. Near the knuckles all are joined by lateral bands; but those of the ring finger tendon being strong, prevent extension of this digit whilst the fingers on the sides (little and middle) are bent.

On the finger each tendon forms a common expansion over the first phalanx with the tendons of the lumbricales and interossei.†

* This common tendon is fixed to the lower part of the condyle, and sends downwards aponeurotic septa on the under and lateral surfaces of three other muscles, viz., the extensor digitorum communis, extensor minimi digiti, and extensor carpi ulnaris.

† On the back of the fore and ring fingers the special extensors of those digits blend with the common expansion.

At the front of the phalanx this expansion divides into three,* S: of these, the central part is fixed into the second phalanx at the base: while the two lateral pieces join, and are inserted as one, T, into the base of the last phalanx. Opposite each phalangeal joint a fibrous expansion is continued from the tendon to the capsule: on the first joint this is indicated by the letter R.

When straightening the fingers the muscle extends the joints from root to tip, separating the digits at the same time; it acts secondarily as an extensor of the wrist. If the elbow has been bent, it can become an extensor, like the other muscles with the common origin.

The *extensor minimi digiti*, F, more or less united with the preceding, is sometimes tendinous in the upper third of the forearm, as is shown in the Plate. Arising by the common attachment, its tendon is divided into two beyond the annular ligament, and the pieces blend on the first phalanx with the other tendons.

The muscle extends the little finger, and exercises afterwards the same action on the wrist joint.

Extensor carpi ulnaris, G. With the common origin above, the muscle is fixed also by aponeurosis to the ulna for three inches below the anconeus, H. Passing through the annular ligament, it has a tendinous insertion into the base of the metacarpal bone of the little finger.

The hand is drawn backwards and to the ulnar side by this muscle.

Anconeus, H. This, the smallest of the superficial muscles, arises, and chiefly by a separate tendon, from the hinder and lower parts of the condyle of the humerus. The fibres give rise to a belly of a triangular shape as they are directed downwards and inwards to their insertion into the upper third of the ulna, on the posterior surface. Some of the upper fleshy fibres seem continuous with the fibres of the triceps.

Inserted into the ulna it will draw backwards this bone—the

* In the natural state a thin membrane connects the pieces, but this was removed in the dissection to render more evident the arrangement of the pieces of the tendon.

humerus being fixed—and will extend the elbow-joint in conjunction with the triceps.

Extensors of the thumb. Three muscles extending the thumb issue between the common extensor of the fingers, E, and the radial extensors of the wrist, C and D. Two, viz., the extensor of the metacarpal bone, K, and that of the first phalanx, L, lie close together on the outer border of the forearm ; and the third, the extensor of the last phalanx, N, is placed below the others, and is separated from them by an interval. The anatomy of these muscles will be found in the description of Plate xii.

Indicator muscle, V. Only below the annular ligament is the tendon of this muscle visible ; and it blends with the common expansion on the first phalanx of the fore finger.

The *posterior annular ligament*, X, confines the tendons of the extensor muscles to the wrist, so as to make the extensors of the digits carry backwards the hand after the digits have been straightened. Formed mostly of transverse fibres, but continuous above and below with the special fascia of the limb, it is fixed externally into the radius ; and internally, where it reaches lower down, into two bones of the carpus—cuneiform and pisiform.

As the tendons are transmitted beneath this fibrous band they are lodged in separate channels. There are six spaces, in which the tendons are arranged in the following order :—The most internal compartment contains the extensor carpi ulnaris, G ; and the one that follows on the outer side is occupied by the extensor minimi digiti, F. The next space receives the common extensor of the fingers, E, and the special extensor of the fore finger, V ; and then comes the sheath for the extensor secundi internodii pollicis, N. Still to the radial side is a large space lodging the two radial extensors of the wrist, C and D ; and most external of all is the tube through which pass the extensor ossis metacarpi pollicis, K, and extensor primi internodii pollicis, L. Each sheath in the ligament is provided with a synovial membrane.

All the tendons, with one exception, lie in grooves in the subjacent bones, and to the edges of the grooves processes of the fibrous tissue are attached. The tendon not resting on the bone is that of the extensor minimi digiti, F, which lies between the

radius and ulna. On the radial side of that extensor the tendons groove the radius in the order stated, and on the ulnar side one muscle (ext. carpi ulnaris) is lodged in a hollow on the ulna.

The *dorsal interosseous muscles*, O, arising from the metacarpal bones bounding each space, are pierced behind by vessels—the external one by the radial trunk, and the others, by the perforating branches from the deep palmar arch. The attachments and the action of these muscles are described with Plate X.

ARTERIES OF THE BACK OF THE HAND.

About the wrist, and on the back of the hand, the arteries are derived from the radial and interosseous vessels, and from the deep palmar arch. Above the wrist only superficial branches of the interosseous appear.

a. Radial artery.
b. Posterior carpal branch.
c. Metacarpal branch.
d. Dorsal branch of the thumb and the index finger.
f. Dorsal interosseous arteries.
g. Branch of the posterior interosseous artery.
h. Posterior part of the anterior interosseous artery.
k. Offset of the recurrent interosseous artery.
† † † Cutaneous offsets of the posterior interosseous artery.

The *radial artery*, *a*, winding over the carpal bones, corresponds with the dorsal artery of the foot in the lower limb, and enters the hand through the first interosseous space. Its connections are the following :—

In addition to the common investments of the limb, with superficial veins and nerves, the three extensors of the thumb are directed over it ;—two, viz., extensor of the metacarpal bone, K, and of the first phalanx, L, lying close together, and in a line with the styloid process of the radius ; and the other, the extensor of the second phalanx, N, crossing close to the spot where it enters the palm of the hand. Beneath the artery are the carpus and the external lateral ligament of the wrist-joint.

Small veins, and ramifications of the external cutaneous nerve accompany the artery.

Its branches are inconsiderable in size, but numerous, and are distributed to the back of the hand and some digits.

The place of the radial artery can be easily ascertained through the skin, if the tendons crossing it are made prominent by extension of the thumb ; and as the vessel is closer to the extensor of the second phalanx than to the others, this tendon should be taken as the guide to it.

Slight wounds on the back of the wrist would be likely to open the artery ; and when the radial lies over the tendons instead of under them, it is still more superficial, and is more exposed to accident.

In disarticulation of the metacarpal bone of the thumb, the artery lies close to the joint, and will be cut unless the knife is kept near the bone.

Branches of the artery supply the carpus, the metacarpus, and the digits.

The *posterior carpal branch*, *b*, forms an arch behind the wrist with a corresponding branch of the ulnar artery, and communicates with the posterior interosseous, *g* ; from the carpal arch interosseous arteries are sometimes given to the inner two metacarpal spaces.

The *metacarpal branch*, *c*, arising here in common with the preceding, runs to the second interosseous space, and ends at the front of the space in two branches for the contiguous sides of the fore and middle digits on the dorsal surface. Behind it receives a perforating branch from the deep palmar arch, and in front it communicates with the digital arteries.

Dorsal interosseous arteries, *f*, *f*, lie over the inner two interosseous muscles, and are derived from the dorsal carpal arch ; or from the perforating arteries of the deep palmar arch, as in the dissection from which the drawing was made. In front they anastomose with the digital arteries ; and if they spring from the dorsal carpal arch, they receive behind the perforating arteries from the deep palmar arch.

Dorsal branches of the thumb and fore finger.—Two small branches belong to the thumb, and these run along the metacarpal bone—one on each side, to the last phalanx : the inner one

of these is marked *d*, and the outer one springs from the radial trunk, about half an inch higher up. There is one branch for the fore finger, which is continued on the radial side of that digit, and supplies the integuments; in this body it is conjoined with the inner artery to the dorsum of the thumb.

Both the posterior interosseous artery, *g*, and the anterior interosseous, *h*, appear near the wrist; but they belong to the deeper dissection, with which they will be described.

DESCRIPTION OF PLATE XII.

THE deep muscles of the back of the forearm, and the posterior interosseous artery and nerve are pictured in this Plate.

The superficial muscles have been cut through near their origin, with the exception of the supinator longus on the one side, and the anconeus on the other. In reflecting the extensors of the fingers, the branches of vessels and nerves to them should be defined at the same time.

DEEP MUSCLES.

In the group of deep muscles at the back of the forearm are included three extensors of the thumb, the special extensor of the fore finger, and the short supinator.

A. Supinator brevis.
B. Extensor ossis metacarpi pollicis.
C. Extensor primi internodii pollicis.
D. Extensor secundi internodii pollicis.
E. Extensor proprius indicis.
F. Common extensor of the fingers, cut.
G. Extensor carpi ulnaris.
H. Anconeus muscle.
K. Extensor carpi radialis brevior.
L. Extensor carpi radialis longior.
M. Supinator longus.
N. Brachialis anticus.
P. Biceps brachii muscle.
R. Triceps brachii muscle.
S. Posterior annular ligament.
† External lateral ligament of the elbow-joint.

The *supinator brevis*, A, nearly encircles the upper part of the radius, and is the highest of the deep muscles. It arises from the ulna below the small sigmoid notch, from the orbicular ligament of the radius, and from the external lateral ligament of the elbow-joint. The fibres curve forwards and downwards, and are inserted into the radius, covering the bone as low as the pronator teres except along a triangular surface on the inner side: the lowest fibres taper to a point externally, and the highest enclose the neck of the radius.

The connections of the supinator with muscles, vessels, and nerves, are numerous and complicated. An anterior view of the muscle is given in Plate ix. Perforating the muscular fibres is the posterior interosseous nerve; and the posterior interosseous artery appears at the lower border.

The muscle turns the upper end of the radius backwards, and supinates the hand. It is the direct antagonist with the biceps of the pronator teres; and in consequence of the attachment of both muscles near the upper end of the radius, they keep the upper fragment supinated in fracture of the shaft of the bone.

Extensor ossis metacarpi pollicis, B, the largest of the thumb extensors, arises from both bones of the forearm, and from the interosseous membrane, viz., from three inches of the radius below the supinator, and from a narrowed surface of the ulna of about the same length, and close to the outer edge.

In company with the next extensor it occupies the outer compartment of the annular ligament; and it is inserted into the base of the metacarpal bone of the thumb, and into the os trapezium (Theile).

It moves the thumb out of the hollow of the hand towards the radius, hence the origin of the term abductor which has been given to it. After the thumb is drawn backwards, the muscle will assist in the extension of the radial side of the wrist.

The *extensor primi internodii pollicis*, C, is the smallest of the extensors, and arises from one bone and the interosseous membrane, being attached to the posterior surface of the radius for about an inch, and to rather more of the interosseous membrane. After passing through the annular ligament, the muscle is

inserted into the base of the nearest phalanx; its tendon is united often with that of the extensor of the metacarpal bone.

Its primary action is to extend the nearest joint of the thumb, and contracting still more the muscle will extend the wrist-joint.

Extensor secundi internodii pollicis, D, arises, like the preceding, from only one bone and the interosseous membrane, and chiefly from an impression on the ulna about four inches long, which lies inside that for the extensor ossis metacarpi. Contained in a separate space in the annular ligament, the tendon is continued over the back of the wrist and the radial extensors of that joint to its insertion into the base of the last phalanx of the thumb.

The muscle will extend the last joint of the thumb; and it can afterwards assist the other extensors in moving backwards the thumb, and extending the wrist.

Extensor indicis, E. The indicator muscle arises inside the preceding, from the shaft of the ulna for three or four inches below the middle (in length), though reaching sometimes as high as the anconeus. Passing through the annular ligament with the common extensor, it is directed to the fore finger, where it joins on the first phalanx the common expansion (p. 101).

The name expresses its action on the fore finger. If all the fingers are opened together, it assists the common extensor. When the fore finger is straightened, the other digits being closed, this muscle alone points the finger; for, during the act, the tendon of the common extensor to that finger is passive, being drawn out of line towards the second finger by the fibrous band connecting the two outer extensor tendons.

Supinator longus, M. In this Plate the peculiar shape of the upper part of the muscle, and the way in which it curves over the long extensor of the wrist to touch the short extensor, can be observed.

The *posterior annular ligament*, S, is described with Plate xi. In the dissection the sheath containing the common extensor of the digits was opened to trace the ending of the posterior interosseous nerve on the back of the wrist.

ARTERIES AT THE BACK OF THE FOREARM.

The posterior interosseous artery, and the ending of the anterior interosseous artery, and of some of its offsets, ramify amongst the muscles on the back of the forearm. Opposite the elbow joint the radial recurrent artery is directed backwards to the superficial muscles.

a. Posterior interosseous artery.
b. Recurrent interosseous.
c. Communicating branch to the anterior interosseous.
d. Continuation of the posterior interosseous artery.
e, e. Perforating offsets of the anterior interosseous.
f, f. Terminal parts of the anterior interosseous.
g. Recurrent radial artery.
h. Trunk of the radial artery.

The *posterior interosseous artery* springs from the common interosseous trunk in front of the limb (p. 83, Plate ix.), and bends back above the interosseous membrane. Appearing, behind, between the supinator, A, and extensor ossis metacarpi, B, it is directed between the superficial and deep strata of the muscles as far as the lower third of the forearm, where it becomes superficial, and courses along the tendon of the extensor carpi ulnaris, G, to the wrist; it ends in offsets, which communicate with the anterior interosseous, *f*, and with the posterior carpal, *b* (Plate xi.). Its named branches are recurrent and muscular.

Muscular branches supply both the superficial and the deep layer; those to the superficial layer have been cut in detaching the muscles.

The *recurrent branch*, *b*, ascends between the supinator, A, and anconeus, H; and supplying both muscles, anastomoses with the superior profunda artery. (Plate vii.)

The *anterior interosseous artery*, *f*, comes from the front, through an aperture in the lower part of the interosseous membrane, and ends on the back of the wrist, anastomosing with the posterior carpal and interosseous arteries; it gives a considerable offset to the outer side of the wrist.

Perforating branches of the anterior interosseous artery, *e, e*, three or four in number, pierce the interosseous membrane, and

anastomose together as well as with the ending of the anterior interosseous, *f*.

Recurrent artery, *g*, of the radial, ascends beneath the supinator longus, M, and communicates with the upper profunda in the arm. (Plate vii.) It supplies the supinator and the radial extensors of the wrist, also the brachialis anticus; and a considerable offset enters the supinator brevis, A, and communicates with the recurrent interosseous.

Radial artery, *h*. The anatomy of the trunk and branches of this artery on the back of the wrist and hand has been given in the description of Plate xi., to which reference may be made.

NERVE OF THE BACK OF THE FOREARM.

The musculo-spiral nerve supplies the extensor and supinator muscles of the back of the forearm.

1. Musculo-spiral trunk.
2. Radial nerve.
3. Posterior interosseous.
4. Branch to the two first extensors of the thumb.
5. Branch to the third extensor of the thumb and the indicator muscle.
6. Continuation of the posterior interosseous nerve.
7. Gangliform enlargement of the nerve on the wrist.

The trunk of the *musculo-spiral nerve*, 1, has been traced through the triceps to the outer part of the arm. (Plate vii.) Guided afterwards by the long supinator, M, and resting on the brachialis, N, it reaches the outer condyle of the humerus, and divides into two—radial and posterior interosseous. Branches from it enter the two muscles mentioned; also the long extensor of the wrist, and sometimes the short extensor.

The *radial nerve*, 2, has solely a cutaneous distribution, and ends in the integuments of the back of the hand, and of the three outer digits.

The *posterior interosseous nerve*, 3, pierces the supinator brevis, and runs between the two strata of muscles to the middle of the forearm. Then sinking under the extensor of the second phalanx of the thumb, it is continued on the interosseous mem-

brane to the back of the wrist, where it swells into a reddish gangliform body, 7, under the tendons of the common extensor, and gives offsets to the articulations.

All the muscles of the deep layer, and those of the superficial layer, except these three—anconeus, long supinator, and long radial extensor of the wrist—receive branches from this nerve.

As the nerve supplies the extensors and supinators of the forearm, injury or disease of it may be attended by paralysis of those muscles; and as the flexor and pronator muscles in front, supplied by different nerves (median and ulnar), would then be unopposed in their action, they would determine the position of the limb. Consequently, after the function of the nerve is destroyed, the hand would be pronated, the wrist bent, and the fingers semiflexed by the action on the joints of the anterior group of muscles. This state of the limb is seen in the colic of painters.

With the subjoined concise notice of the general arrangement of the muscles, vessels, and nerves of the arm, and of the similarity between the two limbs, the anatomy of the upper limb will be brought to an end.

The upper has its counterpart in the lower limb; and with the palm of the hand up, the front of the upper limb is represented by the back of the lower; and the opposite.

The movements of the joints have a close resemblance in the two members; but the scapula and radius, possessing special movements, are provided with some muscles which are not required in the buttock and the leg.

As all the joints in the upper limb bend forwards, the flexors occupy the anterior, and the extensors the posterior surface, contrary to their position on opposite aspects of each segment of the lower limb.

The vessels have a ramified distribution in the arm,—the branches diminishing in size, and increasing in number towards the digits.

The offsets of the artery, unobstructed by valves, join freely

together, and form larger and more frequent anastomoses the nearer they approach the fingers; and in this way provision is made for the onward course of the blood even when the trunk or trunks may be closed.

The veins are provided with valves, which prevent a backward flow of the blood in them, and they are also united by collateral branches, so that the circulating fluid, stopped in one vessel, may be carried upwards more or less perfectly by another channel. Besides the deep veins, which are more numerous than the arteries they accompany, superficial veins ramify in the subcutaneous fat: both sets join at intervals.

The nerves divide and diminish in size, like the arteries, but the branches are very constant, and regular in their distribution: they seldom join each other, unless they are subcutaneous.

All the nerves of the upper limb, with the exception of a few in the integuments of the shoulder and inner side of the arm, come from the brachial plexus. Each of the larger nerves supplies muscles and integuments; the smaller ones end altogether in the muscles about the shoulder; and two (large and small internal cutaneous) belong solely to the teguments.

Three nerves reach the fingers:—of these, one (musculo-spiral) ends on the dorsum, and the other two (median and ulnar) ramifying on the palmar surface of the digits, constitute the nerves of touch.

The three large nerves last mentioned supply most of the muscles below the shoulder:—the musculo-spiral being distributed to the extensors and supinators, and to one flexor in part (brachialis anticus); and the ulnar and median giving branches to the flexors and pronators.

ILLUSTRATIONS OF THE HEAD AND NECK.

DESCRIPTION OF PLATE XIII.

THE base of the skull, with the cranial nerves, and the first and second stages of the dissection of the orbit, may be studied with the aid of this Figure.

After the removal of the brain, the fossæ and the dura mater in the base of the skull are visible without further preparation; but the dissection required for the display of the cranial nerves and the contents of the orbit will be subsequently described.

BASE OF THE SKULL AND THE DURA MATER.

The region called base of the skull is situate inside the cranium, and lies below the level of a line carried circularly round the head from the superciliary eminences in front to the occipital protuberance behind. It is divided into three fossæ on each side of the middle line; and a strong fibrous membrane, the dura mater, lines the whole.

A. Middle fossa of the base.
B. Posterior fossa.
C. Superior occipital fossa.
D. Part of the tentorium, cut through.
E. Part of the falx cerebri, also cut.
F. Falx cerebelli.
G. Straight sinus.
H. Cribriform plate of the ethmoid bone.
I. Crista galli of the ethmoid bone.
K. Roof of the orbit raised.

The *anterior fossa* of the base lies over the orbit, and must be destroyed nearly altogether by the dissection of that space. For

the most part the surface of the fossa is convex, but along the middle line it is hollowed where it lodges the olfactory bulb : at the forepart of the hollow, H, small apertures exist in the cribriform plate of the ethmoid bone for the transmission of the olfactory nerve filaments to the nose. On the anterior fossa rests the anterior lobe of the large brain.

The *middle fossa*, A, receives the middle lobe of the cerebrum or large brain. Much deeper than the anterior fossa, its bottom will reach down to a level with the articulation of the lower jaw. Along the middle line is the depression on the body of the sphenoid bone (sella Turcica) containing the pituitary body. Small vessels ramify in the fossa ; and the internal carotid artery and some cranial nerves cross the inner end.

The *posterior fossa*, B, is more extensive than the others, being wide and shallow, and contains the hemisphere of the small brain or cerebellum. Its depth will be marked on the side of the head by the tip of the mastoid process. In its centre is the large foramen magnum transmitting the spinal cord.

If the skull has not been sawn so low as the occipital protuberance, there will be another depression at the base, the *superior occipital fossa*, C, in which the posterior end or lobe of the large brain rests.

Dura mater. This is a strong fibrous membrane, which serves as an endosteum to the bone, and supports parts of the brain. Its vessels and nerves are named meningeal. Three chief processes project inwards between parts of the brain : two of these are met with in examining the base of the skull, and the third occupies the middle line of the head above the occipital protuberance.

The *tentorium cerebelli*, D (Plate xiv.), is arched over the posterior fossæ of the base, leaving only a small aperture in front for the communication of the spinal cord with the brain ; and it is interposed between the large and small brains. Attached along its middle, above and below, are folds—the falx cerebri and falx cerebelli, which keep it fixed tightly. In its centre is a triangular venous space, the straight sinus, G.

The *falx cerebelli*, F, reaches from the occipital protuberance to

the foramen magnum, and is widest where it joins the tentorium. It contains the occipital sinus.

Falx cerebri, E. Only a small part of this is exhibited. It is narrowed in front and widened behind, and reaches along the middle line of the head from the crista galli, I, to the occipital protuberance where it joins the tentorium (Plate xiv.). At its attachment to the skull lies a venous space, the superior longitudinal sinus (Plate xiv. O).

Meningeal arteries. Small in size and few in number, they ramify in the dura mater of the fossæ, taking the names anterior, middle, and posterior, from their situation. Few of them are seen in an ordinary injection, and they will be noticed more fully after the cranial nerves.

Meningeal nerves. These are smaller than the arteries, and cannot be perceived without steeping the dura mater in acid: they are derived from the sympathetic, and from some of the cranial nerves, especially the fifth.

CRANIAL NERVES IN THE BASE OF THE SKULL.

All the nerves attached to the encephalon are called cranial; and one nerve, 11, not attached to the encephalon, is reckoned as a cranial nerve, because it enters the skull and leaves by an aperture in the base of the cranium. The nerves course forwards from their origin to the apertures of exit; and a part of each nerve is left in the skull after the removal of the brain.

The nerves crossing the middle fossa of the base of the skull are invested by sheaths of the dura mater, but the others are free from the same till they enter their foramina of exit. On the left side, the place of entrance into the sheaths may be observed; but to examine fully the trunks of those nerves, and to define also the ganglion and branches of the fifth nerve, as in the Figure, the dura mater should be removed on the right side from the middle fossa of the base.

There are twelve pairs of cranial nerves:*—these are marked by

* English anatomists reckon in general nine pairs of cranial nerves, and the anatomists on the Continent enumerate twelve pairs; so that some confusion

corresponding numerals, except in the case of the first nerve which has been removed with the brain.

2. Optic nerve and commissure.
3. Motor nerve of the eyeball.
4. Trochlear nerve.
5. Trifacial nerve.
6. Abducent nerve of the eyeball.
7. Facial nerve.
8. Auditory nerve.
9. Glosso-pharyngeal nerve.
10. Pneumogastric nerve.
11. Spinal accessory nerve.
12. Hypoglossal nerve.
13. Gasserian ganglion.
14. Ophthalmic nerve.
15. Superior maxillary nerve.
16. Inferior maxillary nerve.
17. Large petrosal nerve.

The *olfactory*, or *first cranial nerve*, is marked by a bulb which rests on the cribriform plate of the ethmoid bone, and sends filaments to the nose through the subjacent apertures: it will be found attached to the brain.

The *optic*, or *second nerve*, 2, ends in the eyeball. Posteriorly the nerves of opposite sides unite in a commissure (chiasma) on the olivary eminence of the sphenoid bone, with a partial decussation of their fibres. In front the nerves diverge; and each issues from the skull through the optic foramen, with the ophthalmic artery. In the orbit of the left side the further course of the nerve to the eyeball is evident.

The *motor oculi*, or *third nerve*, 3, crosses the middle fossa, and enters its sheath of dura mater behind the anterior clinoid process, as seen on the left side. Contained in the dura mater, it is conveyed to the sphenoidal fissure, and supplies the muscles moving the eyeball, except two.

The *trochlear*, or *fourth nerve*, 4, is received into a sheath of dura mater behind the posterior clinoid process, and courses forwards through the wall of the cavernous sinus to end in one muscle in the orbit—superior oblique.

The *trifacial*, or *fifth nerve*, 5, consists of two roots, large and

in the nomenclature arises from this difference in the mode of numbering. The enumeration of the nerves as twelve appears most natural, as only two nerve trunks, with like function and distribution, will then be included in one cranial pair; whilst, in using the smaller number, as many as four and six trunks, differing in name, function, and distribution, will be combined together as one pair of the cranial nerves.

small, though only the large root is visible, for it lies over and conceals the small root.

The *large root* enters a sheath of dura mater above the petrous portion of the temporal bone, and swells into a large ganglion in the middle fossa of the skull.

This ganglion, 13, named Gasserian, and about as large as the thumb-nail, is widened in front, and is crossed by a ridge which adheres closely to the dura mater. From the fore part of the ganglion three large trunks are sent forwards to end on the face, hence the origin of the name of the nerve:—the highest of these is the ophthalmic trunk, 14, which passes through the sphenoidal fissure to the orbit; the middle one, or the superior maxillary, 15, leaves the skull by the foramen rotundum; and the third, the inferior maxillary nerve, 16, issues from the skull through the foramen ovale. These trunks of the ganglion confer sensibility on the parts to which they are distributed.

The *small* root of the fifth lies under the large one, and will come into view on raising the ganglion; it is unconnected with the ganglion, and belongs exclusively to the inferior maxillary trunk. Blending with offsets of the inferior maxillary trunk outside the skull, it is conveyed to muscles, and chiefly those of mastication, to which it gives the power of contracting.

The *abducent*, or *sixth nerve*, 6, pierces the dura mater behind the body of the sphenoid bone, and entering the cavernous sinus, passes through the sphenoidal fissure to one muscle (external rectus) of the orbit.

All the nerves crossing the middle fossa of the base of the skull, viz., the third, fourth, fifth, and sixth, communicate with the sympathetic on the carotid artery.

The *facial*, or *seventh nerve*, 7, (portio dura of the seventh pair, Willis,) enters the meatus auditorius internus. In the bottom of that hollow it is received into the aqueduct of Fallopius, and is conveyed to the stylo-mastoid foramen, where it escapes, to be distributed to the muscles of the face; it is the motor nerve of the face.

The *auditory*, or *eighth nerve*, 8, (portio mollis of the seventh pair, Willis,) soft, and divided into fibrils, accompanies the facial

into the meatus auditorius, and passes through the small apertures in the bottom of the meatus, to end in the inner parts of the ear.

The *glosso-pharyngeal*, or *ninth nerve*, 9, (part of the eighth pair, Willis,) leaves the skull by the foramen jugulare, being contained in a distinct sheath of dura mater, and lying in a depression in the lower border of the temporal bone. It is distributed, as the name expresses, to the tongue and pharynx.

The *pneumogastric*, or *tenth nerve*, 10, (part of the eighth pair, Willis,) is transmitted through the foramen jugulare in a sheath of dura mater common to it and the following nerve. It is a flat nerve, consisting of fibrils. Its terminating branches ramify in the air passages, the heart, and the alimentary canal.

The *spinal accessory*, or *eleventh nerve*, 11, (part of the eighth pair, Willis,) is the only cranial nerve that does not begin in the encephalon. Arising from the spinal cord, it enters the skull through the foramen magnum ; it then bends outwards to the foramen jugulare, and leaves the skull through that hole in close contiguity to the pneumogastric—the two being contained in the same fibrous sheath. This nerve supplies in part two muscles of the neck—the sterno-mastoid and trapezius.

The *hypoglossal*, or *twelfth nerve*, 12, (ninth pair, Willis,) consists of two bundles of filaments, which pierce separately the dura mater. These join in the anterior condyloid foramen, by which they issue from the cranium as one trunk. It is a motor nerve of the tongue muscles.

Large petrosal nerve, 17.—This is a continuation of the Vidian nerve, derived from Meckel's ganglion. Coming into the skull through the foramen lacerum in the base, it is conveyed in a bony groove under the Gasserian ganglion to the hiatus Fallopii, which it enters to join the facial nerve in the temporal bone.

VESSELS IN THE BASE OF THE SKULL.

Two large arteries on each side, carotid and vertebral, pass through the base of the skull in their course to the brain, and furnish some offsets to the dura mater. Other meningeal vessels,

supplied from arteries outside the cavity of the skull, ramify in the dura mater.

a. Internal carotid artery.
b. Vertebral artery.
c. Large meningeal artery.
m. Posterior meningeal artery.
n, n. Anterior meningeal arteries.

The *internal carotid artery, a,* issues from the carotid foramen in the apex of the temporal bone, and winding through the cavernous sinus (Plate xiv.), touches the brain at the inner end of the fissure of Sylvius, and splits into branches (cerebral) for the supply of the large brain or cerebrum. On the side of the sphenoid bone it makes two bends, lying internal to the cranial nerves; and at the base of the brain it is placed between the second and third nerves.

An ophthalmic branch, and small offsets to the dura mater, spring from this part of the carotid.

The *vertebral artery, b,* is a branch of the subclavian trunk, and enters the skull through the foramen magnum: the arteries of opposite sides soon coalesce, and they supply the small, and part of the large brain. An offset is furnished by it to the dura mater.

Meningeal arteries. Small arteries ramify in each fossa of the base of the skull: they are named anterior, middle, and posterior, like the fossæ.

The *anterior set,* two in number, *n, n,* and the smallest, are branches of the ophthalmic artery in the orbit: they come from the anterior and posterior ethmoidal arteries, and entering the skull at the edge of the cribriform plate, end in the middle part of the fossa. One sends a twig to the front of the falx cerebri, E.

The *middle set,* three in number, are derived from branches of the external carotid artery, and appear through the lacerated, oval, and spinous foramina. The largest of these, and the only one generally injected, is the following :—

The middle meningeal artery, *c,* nourishes chiefly the bony case containing the brain. Arising from the internal maxillary artery, it comes inwards through the foramen spinosum, and ascends to the top of the head, grooving the bones—more particularly the lower and fore parts of the parietal. At the vertex of the skull it

terminates in the bone, but some branches communicate with the arteries on the outer surface of the cranium.

Branches are given by it to the dura mater. A petrosal branch enters the hiatus Fallopii with the small nerve, 17, to supply the temporal bone; and one or two offsets penetrate into the orbit, and join the ophthalmic artery.

The *posterior set* includes two arteries: one is furnished by the occipital through the foramen jugulare, and the other, by the vertebral artery inside the skull. Of the two, the offset, *m*, from the occipital is the largest, and it extends even to the tentorium cerebelli.

Veins. No vein accompanies either the internal carotid or the vertebral vessels which end in the brain; but companion veins run with the arteries distributed to the dura mater and the brain case. The veins with the large middle meningeal artery may be plainly seen in a dissection.

CONTENTS OF THE ORBIT.

In the orbit is lodged the eyeball with its muscles, vessels, and nerves. And the gland for the secretion of the tears is contained in the fore part of the same cavity.

The dissection of this cavity requires some care in its execution, in consequence of the smallness of the vessels and nerves, and of the quantity of fat with which they are surrounded.

On the right side the first stage of the dissection has been prepared by sawing through and throwing forwards the bony roof; and then slitting along the middle and removing the periosteum of the cavity. On the left side, the cavity having been opened as before, the superficial layer has been taken away, to bring into view deeper vessels and nerves.

SUPERFICIAL MUSCLES AND THE LACHRYMAL GLAND.

The muscles contained in the orbit act on the eyeball, with the exception of one which raises the upper eyelid. Six muscles are attached to the eyeball; of these, four are straight, and direct the

pupil to opposite points of the circumference of the orbit; whilst two, which are named oblique, roll the ball.

L. Lachrymal gland.
M. Eyeball of the left side.
N. Upper oblique muscle.
P. Levator palpebræ superioris.
R. Upper rectus muscle.
S. External rectus muscle.
T. Pulley of the upper oblique muscle.

The *lachrymal gland*, L, lies above the muscles in the outer part of the orbit, and touches in front the upper eyelid. Shaped somewhat like an almond, with its longest measurement directed transversely, it is suspended by fibrous tissue to the roof of the orbit. It secretes the tears; and its ducts, six or eight in number, open along an arched line on the inner surface of the upper lid, near the outer end.

The *upper oblique muscle*, N, (trochlearis) is the longest muscle in the orbit, and passes through a ring, or pulley. It arises from the frontal bone, close to the optic foramen in the bottom of the orbit; and ends anteriorly in a tendon, which is directed backwards through the pulley, but beneath the upper rectus, and is inserted into the eyeball behind the centre (Fig. xiv.).

The trochlea or pulley, T, is a ring of fibro-cartilage, which is attached to the pit near the inner angle of the frontal bone. A synovial membrane lines the ring, and fibrous tissue is prolonged from the margins along the tendon.

The muscle acting, raises and draws forwards the back of the eyeball, rotating it at the same time; and it gives to the pupil "perhaps a very slight inclination downward and outward."*

The *levator palpebræ superioris*, P, arises in the bottom of the orbit, close to the preceding; becoming tendinous in front of the eyeball, it enters the upper eyelid, and is inserted into the fore part of the tarsal cartilage.

The muscle elevates the upper eyelid, moving upwards the fibro-cartilage over the eyeball, and gives rise to a deep groove in the skin. If the eyeball is directed down when the muscle is acting,

* This action is attributed to it by Dr. Jacob, in the Dublin Medical Press for Jan. 6, 1841, p. 1.

the elevation of the lid is checked by the mucous membrane which is then less loose.

Recti muscles.—The upper rectus, R, (attollens oculi) and the outer rectus, S, (abductor oculi) have a common origin with the other two recti, around the optic nerve, at the apex of the orbital cavity ; and they are inserted into the eyeball about a quarter of an inch behind the cornea.

The outer rectus is provided with an additional origin from a point of bone on the lower edge of the sphenoidal fissure, near the inner end of that slit : between this head and the common one the ophthalmic vein and several nerves pass.

The pupil is directed towards the eyebrow by the upper rectus muscle, and outwards by the other rectus—the insertion of the muscles into the ball in front of its greatest transverse diameter impressing on the eye the movements stated. Squinting upwards or outwards may result from permanent contraction of the muscle moving the eye in the direction indicated, or from the rectus in action being unbalanced through paralysis of its antagonist muscle or muscles.

VESSELS OF THE ORBIT.

The ophthalmic artery and vein are represented in the left orbit. These vessels have some peculiarities :—they are not transmitted through the same aperture in the bone ; and the vein, which is a single trunk, ends in the cavernous sinus in the interior of the skull.

d. Ophthalmic artery.
e. Anterior ethmoidal or nasal artery.
f. Posterior ethmoidal artery.
g. Supra-orbital artery.
h. Ophthalmic vein.

The *ophthalmic artery*, *d*, is a branch of the internal carotid, and enters the orbit through the optic foramen, lying below and outside the optic nerve. In the left orbit the artery is shown coursing over the optic nerve, and along the inner side to the front of the cavity, where it ends in branches for the root of the nose (nasal) and the forehead (frontal). Most of its offsets are distributed in the orbit.

Offsets for the eyeball. Several branches, *posterior ciliary*, pierce the back of the eyeball around the optic nerve. Other smaller arteries, which are usually not injected, enter the front of the ball, close to the cornea: these are the *anterior ciliary*, and they are best seen in inflammation of the iris. One artery enters the optic nerve behind the ball; it ramifies in the retina, and is called the *central artery of the retina.*

The *lachrymal branch* accompanies the nerve, 19, to the gland of the same name.

Muscular branches arise at intervals: some of these are seen in the Figure.

Eyelid offsets. Each eyelid receives a *palpebral* branch: these are directed transversely, in contact with the tarsal cartilages, and anastomose externally with the lachrymal—forming an arch in each lid.

Branches leaving the orbit.—Besides the two terminal branches (frontal and nasal), three others leave the cavity. One, *anterior ethmoidal, e*, accompanies the nasal nerve to the nose, and supplies meningeal offsets. Another, *posterior ethmoidal, f*, smaller than the preceding, passes through the foramen of the same name to the dura mater in the anterior fossa of the skull. And the third, *supra-orbital, g*, runs with the nerve of the same name through the supra-orbital notch to the forehead.

The *ophthalmic vein, h*, taking the same general course as the artery, joins in front the facial vein; and as its branches correspond mostly with those of the artery few are delineated. At the back of the orbit it leaves the artery, and passing between the heads of the outer rectus, ends in the cavernous sinus in the skull (Plate xiv. Q).

Eyeball-veins: — these differ from the arteries to the ball. Four in number, they issue on opposite sides of the eye, and about midway between the cornea and the entrance of the optic nerve.

NERVES OF THE ORBIT.

Five cranial nerves enter the orbital cavity, viz. 2nd, 3rd, 4th, 5th, (in part) and 6th; and all, except the second or optic,

come through the sphenoidal fissure. Some end in the contents of the orbit, like the arteries, and others are transmitted through the cavity to the nose and the forehead: they have the following general distribution. The second or the optic belongs to the eyeball. The third, fourth, and sixth, are furnished to muscles. And the ophthalmic trunk of the fifth nerve supplies the eyeball and the lachrymal gland, and ends outside the orbit.

The nerves which are superficial to the muscles are displayed on the right side, viz. the fourth, and the supra-orbital and lachrymal branches of the fifth: on the left side the other nerves referred to in the description may be observed.

2. Optic nerve.
3. Third nerve.
4. Fourth nerve.
14. Ophthalmic nerve of the fifth.
18. Supra-orbital nerve.
19. Lachrymal nerve.
21. Upper branch of the third nerve.
23. Continuation of the nasal nerve.

The *third cranial nerve*, 3, (motor oculi) supplies all the muscles of the eyeball except two, and enters the orbit in two pieces between the heads of the external rectus. The upper and smaller part, 21, (left side) is furnished to the levator palpebræ, P, and the upper rectus, R; the lower portion of the nerve may be seen in Plate xiv. 22.

The *fourth cranial nerve*, 4, passes through the sphenoidal fissure above the muscles, and ends in the upper oblique, N, piercing the fibres of the muscle on the surface turned away from the eyeball.

The *ophthalmic nerve*, 14, begins in the Gasserian ganglion, 13, and is continued through the wall of the cavernous sinus and the sphenoidal fissure to the orbit. It ends by dividing into the supra-orbital, 18, and the lachrymal branch, 19; and from its inner side, before the terminal bifurcation, springs the nasal nerve, 20, (Fig. xiv.)

The *lachrymal nerve*, 19, the smallest of the offsets of the ophthalmic trunk, is directed to the outer part of the orbit, and supplies the lachrymal gland and the upper eyelid.

The *supra-orbital nerve*, 18, lies above the muscles, like the lachrymal, and is continued through the cavity to the supra-

orbital notch, where it issues on the forehead, and supplies the muscles and the integuments. From its inner side is given a long slender branch, *supra-trochlear*, to the upper eyelid and the forehead; and as it turns round the margin of the orbit, small *palpebral* filaments are furnished to the upper eyelid.

The *nasal nerve* (20 left side) ends in the nose, and passes through the orbit and the cavity of the skull before it reaches its destination. Entering the orbit between the heads of the external rectus (Plate xiv.) it is continued forwards with the ophthalmic artery to the anterior of the two foramina in the inner wall (23, left side); here it is transmitted to the cavity of the skull. In the orbit its offsets are the following :—

Firstly, there is a slender communicating branch to the lenticular ganglion (Plate xiv. 26). As it crosses the optic nerve two or three filaments, *long ciliary*, are furnished to the eyeball. And as it leaves the orbit it gives a branch—*infra-trochlear*, 24, to the upper eyelid and the side of the nose.

The nasal nerve is distributed finally to the mucous membrane of the front of the nasal cavity, and to the integuments of the end of the nose. Irritation of it in the nasal cavity, as in taking snuff, induces sneezing for the purpose of removing the irritating body.

Sixth cranial nerve, 6. The ending of this nerve in the external rectus is delineated in Fig. xiv.

DESCRIPTION OF PLATE XIV.

In the Drawing a view is obtained of the dura mater at the base of the skull, with the cavernous sinus, and the dissection of the orbit is carried through its two deeper stages.

Parts delineated in this and the preceding Plate are marked by the same letters and figures.

THE DURA MATER WITH THE SINUSES.

The *tentorium cerebelli*, D, has been left entire for the purpose of showing the level and extent of this partition. Its position will be marked on the surface by a line on a level with the part of the ear joining the side of the head.

Venous spaces occupy the middle part, and the attached edge of the membrane; and one of the largest spaces, called the cavernous, is close to each anterior extremity.

The *cavernous sinus*, Q, may be opened, as on the left side, by cutting through the dura mater from the anterior clinoid process to the petrous portion of the temporal bone, the cut being made internal to the third and fourth nerves.

This hollow is placed on the side of the body of the sphenoid, and reaches from the sphenoidal fissure to the temporal bone. Rather more than an inch long, it measures across about half an inch, after the knife-handle has been put into it; and it is dilated behind where it joins other sinuses. Its inner boundary is formed by the sphenoid bone covered by thin dura mater; and the outer boundary consisting of thickened dura mater, contains the third, 3, fourth, 4, and the ophthalmic trunk of the fifth nerve, 14, Plate xiii.

Through the inner part of the space pass the internal carotid artery and the sixth cranial nerve; and these are separated from the blood by the thin venous lining membrane. Small fibrous bands and arteries traverse the space, giving rise to the term "cavernous."

Blood is received from a few small cerebral veins which pierce the outer wall, though chiefly from the ophthalmic vein (Fig. xiii. *h*) which enters in front; and it circulates backwards to be conveyed to the lateral sinus by the upper and lower petrosal sinuses. The blood in the space communicates with that outside the head by means of small emissary veins which penetrate through the foramen lacerum.

Three short sinuses join the cavernous spaces of opposite sides across the middle line;—one lying before the pituitary body, one behind it, and the other across the basilar process of

the sphenoid bone. No valves exist in these cross channels, so that the blood can move freely forwards and backwards through them ; and should the diminished size or the absence of one lateral sinus interfere with, or stop the course of the blood on that side of the skull, the circulating fluid can be conveyed across the middle line, to be transmitted from the head by the lateral sinus of the opposite side.

The *internal carotid* artery, *a*, winds through the space from behind forwards, and issues through the dura mater internal to the anterior clinoid process : it furnishes here small *receptacular* branches to the dura mater.

Ascending around the artery is the cranial part of the *sympathetic nerve*, which communicates with the nerves entering the orbit through the sphenoidal fissure.

In the sinus lies the *sixth cranial* nerve, 6, which courses from behind forwards, close outside the carotid artery, and communicates largely with the sympathetic.

Another large central sinus, named *torcular Herophili*, is placed opposite the occipital protuberance, and receives blood from the brain. Opening into it in front is the straight sinus G, (Plate xiii.); above is the superior longitudinal, O ; and below is the occipital sinus contained in the falx cerebelli. On each side issues the large lateral sinus, which extends to the foramen jugulare, joining there the internal jugular vein, and conveys from the skull the blood both of this and of the cavernous sinus.

DISSECTION OF THE ORBIT.

The third stage of the dissection, which is represented on the right side, will be obtained by clearing away the vessels shown in the left orbit in Plate xiii. And the preparation of the last stage, as exhibited on the left side, may be made by removing the lenticular ganglion and the nasal nerve, and by dividing the optic nerve and raising the ends.

MUSCLES OF THE ORBIT.

The muscles lying below and to the inner side of the eyeball

act as antagonists to the group of muscles (before described, p. 121) on the outer side and above the ball. Like the other group they consist of two straight and one oblique; and they are named inferior rectus, internal rectus, and inferior oblique.

N. Upper oblique muscle.
O. Superior longitudinal sinus.
P. Levator palpebræ superioris.
Q. Cavernous sinus.
R. Upper rectus muscle.
S. External rectus muscle.
V. Inferior rectus muscle.
W. Inferior oblique muscle.
X. Internal rectus muscle.

Recti muscles. The lower rectus, V, (depressor oculi) and the inner rectus, X, (adductor oculi) arise, behind, around the optic nerve with the other muscles; and the two separating from each other in front, are inserted into the eyeball near the cornea, each being attached opposite its antagonist muscle.

One of these muscles contracting, the pupil will be directed towards it, the under rectus depressing, and the inner one adducting the eye; but the two recti acting together the pupil will be directed to a point intermediate between both.

The *external rectus*, S, is more evident here than in Figure xiii.; and on the right side the nerves passing between its heads of origin, viz., the third, 3, the nasal nerve of the fifth, 20, and the sixth, 6, have been traced out, to show their relative position.

The *inferior oblique muscle*, W, is displayed only at its insertion into the eyeball. Arising from the fore part of the floor of the orbit, close to the lachrymal sac, it is inclined backwards below the inferior rectus and the eyeball, and is inserted into the back of the eye near the upper oblique muscle.

By the action of this muscle the back of the ball will be depressed and the cornea raised; and the eye being rotated at the same time "the cornea will be directed perhaps a little upwards and inwards."*

DEEP NERVES OF THE ORBIT.

The second nerve, part of the third nerve, the lenticular

* Dr. Jacob gives this as its probable action. See the Dublin Medical Press of Jan. 6, 1841, before referred to.

ganglion, and the sixth nerve, are met with in the two deeper stages of the dissection of the orbit.

On the right side the lenticular ganglion is depicted, with the optic nerve; and the other nerves are visible on the left side.

2. Optic nerve.
3. Third cranial nerve.
4. Fourth nerve.
5. Fifth cranial nerve.
6. Sixth cranial nerve.
13. Gasserian ganglion.
20. Nasal nerve at its origin.
21. Upper branch of the third nerve.
22. Lower branch of the third nerve.
23. Nasal nerve leaving the orbit.
24. Infra-trochlear nerve.
25. Lenticular ganglion.
26. Long root of the lenticular ganglion to the nasal nerve.

The *optic* or *second cranial nerve*, 2, lies in the middle of the hollow included by the recti muscles, and enters the back of the eyeball rather internal to the centre: it spreads out in the nervous stratum of the retina. Along it the ciliary arteries and nerves are conveyed to the eyeball.

The *ophthalmic* or *lenticular ganglion*, 25, is a small rather red body, about as large as a pin's head of moderate size, which is situate at the back of the orbit, close to the ophthalmic artery and the optic nerve. Nerves issue from it at four points (angles): two pass backwards, joining other nerves, and these are called roots; and several nerves are sent forwards to the eyeball along the optic nerve.

Posterior branches.—A long slender branch—the long root, 26, joins the nasal nerve, 20. Another thick and short branch—the short root, unites with the third nerve, 22, (right side). Sometimes a third offset, between those two, connects the ganglion with the sympathetic.

The anterior branches or the short *ciliary* nerves to the eyeball, are about twelve in number, and form two bundles, upper and lower: they are furnished to the ball, and especially to the muscular structure in it.

The *third cranial nerve*, 3, splits into two as it is about to enter the orbit between the heads of the outer rectus. Its upper piece, 21, ends in the upper rectus, and in the elevator of the upper eyelid.

The lower and larger part of the nerve, 22, (left side) divides into three: one enters the inferior rectus, V; the second belongs to the internal rectus; and the third offset, 22, (right side) is continued below the eyeball to the inferior oblique muscle. The last branch is joined by the short root of the lenticular ganglion, and supplies through that communication motor nerves to the muscular fibres of the eyeball.

Paralysis of the muscles supplied by the third nerve is attended by dropping of the eyelid, and inability to raise it; and the eye loses its movements in certain directions. Supposing its existence on one side, the cornea could not be moved vertically, that is to say, it could not be turned upwards or downwards by the elevator and depressor muscles; it could not be drawn inwards horizontally by the adductor; nor could it be inclined upwards and inwards by the inferior oblique—all the muscles needful for those movements being supplied by the nerve, and being therefore unable to contract. Only two movements would remain, viz. abduction and rotation downwards and outwards:—the former depending on the external rectus which is supplied by the sixth nerve; and the latter on the superior oblique, which receives the fourth nerve.

Double vision will accompany the paralysis when an attempt is made to look with both eyes to the temple of the opposite or healthy side; and this occurrence is to be accounted for by the loss of the muscular control over the ball of the affected side. In looking with both eyes to the temple (left) in the undiseased state of the muscles, the left eye will be inclined outwards by the external rectus, and the right eye will be turned inwards, towards its fellow, by the internal rectus. But in paralysis, say of the right side, the affected eye cannot be inclined towards its fellow in consequence of the internal rectus having lost its power of contracting, whilst the healthy or left eye will be turned outwards by the external rectus muscle; and as the axes of the eyes are not kept parallel, images are formed on non-corresponding points of the two retinæ, and double vision results.

The *sixth cranial nerve*, 6, enters the orbit between the heads of the external rectus, lying below the third and nasal nerves,

and above the ophthalmic vein: it is distributed to the external rectus muscle.

In paralysis of the external rectus from disease of this nerve the eyeball cannot be directed outwards; and squinting inwards may ensue from the absence of a contracting muscle to balance the internal rectus.

Orbital branch of the *upper maxillary* nerve. After the contents of the orbit have been removed, this small nerve may be found in the lower and outer angle, passing through the orbit on its way to the face and the temple.

DESCRIPTION OF PLATE XV.

THIS Figure illustrates the anatomy of the side of the neck behind the sterno-mastoid muscle.

The position of the body indicated in the drawing will be required also during the dissection, viz. the arm having been drawn down to depress the shoulder, and make tense the neck muscles.

The more prominent lateral muscles will appear readily on reflecting the skin by the incisions marked in the Plate, and on removing the thin platysma muscle, and the deep cervical fascia; but much time and care will be needed to make clean, and to leave uninjured the deeper nerves and vessels.

MUSCLES OF THE SIDE OF THE NECK.

All the muscles here exhibited in part, are attached below either to the arch formed by the clavicle and the scapula, or to the first rib; and above they are fixed to the head and the spinal column, with the exception of the omo-hyoid which is attached to the hyoid bone. A hollow, the posterior triangular space, intervenes between the two largest superficial muscles.

A. Platysma myoides.
B. Sterno-cleido-mastoid muscle.
C. Splenius capitis.
D. Trapezius.
E. Levator anguli scapulæ.
F. Scalenus medius.
G. Scalenus anticus.
H. Omo-hyoideus.
K. Deltoid muscle.
L. Clavicle.
N. Pectoralis major.

Platysma myoides, A. This is a membraniform fleshy layer, which is contained in the fatty stratum between the skin and the deep fascia. Arising from the scapular arch, and the top of the thorax and shoulder, it crosses the side of the neck, and is inserted into the base of the lower jaw, blending with muscles of the face.

It covers the external jugular vein, *k*, and the lower two thirds of the posterior triangular space. Its fibres are inclined downwards and backwards from the jaw to the shoulder ; and in opening the external jugular vein in venesection the incision is to be so directed as to cut them across.

The *sterno-cleido-mastoid muscle*, B, crosses the neck obliquely from the thorax to the ear. Below it arises from the first piece of the sternum, and the inner third of the clavicle (Plate xvii.); and it is inserted above into the mastoid process, and the upper curved line of the occipital bone.

From its diagonal position in the neck it separates a triangular surface in front from another behind : it covers the great carotid blood vessels and the neck muscles, and it is crossed by superficial nerves and veins. It is pierced by one large nerve—the spinal accessory or the eleventh cranial nerve, 13.

Both muscles acting, the head will be brought forwards, as in nodding, or the sternum will be raised ; according as they may take their fixed point above or below. If only one muscle is used the head is turned to the opposite side ; but in combination with other muscles attached to the mastoid process it can incline the head towards the shoulder on the same side.

In wry-neck (torticollis) arising from muscular contraction, the sterno-mastoid forms a hard, tense cord on the side of the neck opposite to that to which the head is turned. Subcutaneous cutting through of the muscle is practised to remove the deformity.

The *trapezius*, D, attached behind to the spinal column and

the head, is inserted in front into the outer third of the clavicle, and into the acromion process and the spine of the scapula.

The anterior free edge of the muscle limits behind the posterior triangular space ; it is thin in the upper half, and it is projected forwards, as a point, opposite the fourth cervical nerve and the narrowed part of the neck.*

The fore part of the trapezius will help the levator anguli scapulæ, E, in raising the shoulder.

Splenius capitis, C. This small part of the splenius muscle appears in the posterior triangular space, where it arches forwards from the spinal column to the mastoid process.

Taking its fixed point behind it can turn the face to its own side ; or acting with the sterno-mastoid, it will incline the head to the shoulder. When the muscles of opposite sides act together, the head will be carried backwards.

Levator anguli scapulæ, E, occupies the hinder part of the triangular space. It arises from the transverse processes of the three or four upper cervical vertebræ, and is inserted into the base of the scapula (Plate v. C.) ; its processes of origin may remain separate for some distance as in the Plate, and appear like distinct muscles.

Its ordinary action is manifested in shrugging the shoulders ; in this movement it is assisted by the upper part of the trapezius.

The *omo-hyoideus* is a double-bellied muscle, which reaches from the scapula to the hyoid bone, and is tendinous beneath the sterno-mastoideus (Plate xviii.) : for the anatomy of the anterior belly, see Plate xvii.

The fibres of the posterior belly, H, are attached beneath the trapezius to the upper border of the scapula, close to the notch in that bone ; and they end in front in the intermediate tendon. This belly crosses the posterior triangular space, cutting off a small part below, which contains the subclavian artery ; and it is kept in place by a sheath of the cervical fascia.

* When this edge is represented in Anatomical Plates as straight between the upper and lower attachments, the displaced condition is delineated.

This belly of the muscle makes tense the deep fascia of the neck. The possibility of its compressing the internal jugular vein has been suggested by Theile.*

The *scaleni muscles*, three on each side, pass from the first two ribs along the side of the spinal column, and are crossed by the great nerves and vessels of the upper limb.

The *anterior muscle*, G, arises from the first rib around a slight prominence on the upper surface; and it is inserted into the fore part of the transverse processes of four cervical vertebræ, viz. 6, 5, 4, 3.

In front of the muscle lie the omo-hyoideus, H, and sterno-mastoideus, B; but the deep connections can be more fully observed in Plate xviii. With a lateral view of the side of the neck, as in the Figure, part of the muscle may be seen in the posterior triangular space; but in a front view, the muscle is usually concealed by the sterno-mastoideus.

The *middle muscle*, F, larger than the preceding, arises from a groove across the hinder part of the upper surface of the first rib; and it is inserted into the posterior part of the transverse processes of all the cervical vertebræ.

Along its outer edge lies the levator anguli scapulæ; and it is placed beneath the cervical nerve trunks, and the subclavian artery.

The *posterior muscle* is small, and is concealed by the preceding. Arising from the upper border of the second rib at the back, it is inserted into the transverse processes (posterior tubercles) of two or three lower cervical vertebræ.

When the neck is fixed the scaleni will elevate the first two ribs. When the ribs are fixed the movements of the neck will vary with the action of the different muscles. If the scaleni of one side contract, the neck will be inclined laterally towards the muscles acting; but if those of both sides come into play at once—the one set antagonizing the other—the vertebral column will remain upright. Should the anterior scaleni of both sides act the neck would be bent forwards, in consequence of their attachment in front of the spine.

* "Lehre von den Muskeln," Leipzig, 1841.

Another muscle, the *serratus magnus*, lies in the lower and outer angle of the triangular space, viz., where the omo-hyoideus and the trapezius meet; it is concealed by the trapezius.

POSTERIOR TRIANGULAR SPACE OF THE NECK.

The intermuscular interval on the side of the neck, named the posterior triangular space, is narrow before the fascia is removed, like the corresponding hollows opposite the joints, but in the drawing the space is delineated as it appears after dissection. The great artery of the upper limb, and the cervical nerves, together with much fat and interspersed lymphatic glands, are contained in this hollow.

This interval reaches from the clavicle to the back of the head. It is bounded in front by the sterno-mastoid, B, and behind by the trapezius muscle, D. By its dissection greater apparent length is given to the neck, in consequence of the teguments being removed from part of the head.

Narrower above than below, the space is said to be triangular. Rather it is flask-shaped, with the small part directed upwards. As low as the letter D, the hollow is shallow, and the sides nearly straight; but beyond that spot it becomes deeper, and is widened in consequence of the posterior border being curved. When in its natural position the upper part of the sterno-mastoid projects farther back towards the trepezius than is indicated in the drawing.

Stretched over the space are the skin, the subcutaneous fatty layer containing the platysma, A, and the deep cervical fascia. And the floor of the hollow is formed by the superficial stratum of the muscles of the side of the neck, in the following order. Beginning above, the splenius capitis, C, is first met with; and below it lies the levator anguli scapulæ, divided into parts and marked by E, E. Farther down comes the scalenus medius F; and near the clavicle the serratus magnus projects above the first rib, but this would be visible under the trapezius only in a front-view.

The space is divided into two unequally-sized parts by the small

omo-hyoid muscle, H—the lower being designated clavicular, and the upper occipital.

The *occipital part*, much the larger of the two, occupies nearly the whole length of the neck. It has the same bounds in front and behind as the large hollow, and it is limited below by the omo-hyoideus, H. Its depth increases towards the lower boundary; and in it are contained chiefly nerves, with some small vessels, and lymphatics.

The *nerves* issue from beneath the sterno-mastoid muscle, and unite in a plexiform manner—the upper nerves entering the cervical, and the lower the brachial plexus.

From the nerves, 1 and 2, of the cervical plexus, superficial branches are directed upwards and downwards :—The ascending set reach the fore part of the neck, the ear and contiguous part of the face, and the back of the head; and the descending set, more numerous than the other, are continued through the space to the integuments of the top of the chest and shoulder.

The lower cervical nerves join in the brachial plexus, 11. These trunks are inclined downwards through the lower end of the occipital part, and through the clavicular part of the triangular space to the axilla : they give few branches, and their position will be referred to again.

One large nerve, 13, the *spinal accessory*, (eleventh cranial nerve) crosses the space obliquely downwards and backwards, from the border of the sterno-mastoid to the under surface of the trapezius.

Vessels.—The arteries are small in size, and supply the surrounding muscles : they appear behind the sterno-mastoideus. The lowest and largest is the transverse cervical artery, *c*, which passes beneath the trapezius. Veins accompany the arteries, their size corresponding with that of their companions.

The *clavicular part* of the posterior triangular space has its sides formed by the clavicle, L, and the omo-hyoideus, H; and its base or fore part by the sterno-mastoideus, B. Towards the surface it is covered by the same layers as the great triangle ; and the floor is constructed by the scaleni muscles, the serratus magnus, and the first rib.

Larger before than behind, it is placed nearly opposite the middle third of the clavicle. It is about one inch and a half long, and an inch wide in front after the dissection; but until the omo-hyoideus has been displaced, the muscle will lie closer to the clavicle, diminishing thus the width. Contained in it are the subclavian artery, *a*, the brachial plexus, 11, and the external jugular vein, *k*, with their offsets, together with lymphatics and the usual fat.

Arteries.—The subclavian trunk, *a*, crosses the space from within out. In front it issues from beneath the anterior scalenus, G, and it disappears below beneath the clavicle. Along the side of the space formed by the clavicle, the supra-scapular vessels, *b*, lie under cover of that bone. And at the corner where the omo-hyoideus meets the sterno-mastoideus, the transverse cervical vessels, *c*, cross the hollow.

Veins.—If the subclavian vein is full it may appear beneath the clavicle, though it lies usually at a lower level than the artery. The external jugular vein, *k*, is directed across the space, to join the subclavian vein below: companion veins, *l* and *n*, of the transverse cervical and supra-scapular arteries enter it near the clavicle.

Nerves.—External to the artery, or higher in the neck than it, the large bundles of nerves entering the brachial plexus are directed downwards in their course to the arm-pit: they have a deep position like the artery, and occupy the interval between the vessel and the omo-hyoid muscle. Near the outer part of the space they approach nearer to the vessel, and serve as a valuable guide to it from the constancy of their position, and by their white appearance and firm feel. Over the space descend the superficial branches of the cervical plexus: these must be divided in an incision into the neck.

The size of the clavicular part of the triangular space varies much with the condition of the bounding muscles. Alterations in length will be determined by the attachment of the trapezius and sterno-mastoideus to the clavicle, for if one or both should reach farther than usual on that bone, the intermuscular space must be diminished accordingly. The width will be dependent upon the size and the situation of the omo-hyoideus, H. When the muscle

is wide, or lies close to the clavicle, the dimensions from above down of the clavicular part of the triangular space will be less than when the muscle is narrow, or is placed at a greater distance from the bone. In some bodies the omo-hyoideus arises from the back of the clavicle, and conceals the subclavian artery, so that there is not any interval in the usual place between the muscle and the collar bone.

Differences in depth will arise from varying states of the neighbouring parts. In a long and thin neck, with low and flat clavicles, the depth is not so great as in a short and thick neck with prominent and much curved collar bones. Changes in the position of the shoulder will give rise also to variations. Thus if the shoulder is depressed by drawing down the arm, the space is as shallow as it can be made ; whilst raising the shoulder gives to the hollow its greatest depth. And by forcing upwards the shoulder the clavicle can be carried as high as, or even higher than the level of the omo-hyoid muscle and the subclavian artery.

ARTERIES IN THE TRIANGULAR SPACE.

In the lower part of the triangular space are contained the trunk of the subclavian artery, with some of its branches. Towards the ear are other small arteries, which are derived from the external carotid trunk.

a. Subclavian artery.
b. Supra-scapular artery.
c. Transverse cervical artery.
d. Cutaneous branch of the subclavian.
e, f. Branches of the ascending cervical artery.
g. Posterior auricular artery.
h. Cutaneous offset of the posterior auricular.

Subclavian artery, a. The third part of the arch of the subclavian trunk (Plate xviii.) lies in the clavicular portion of the posterior triangular space; and it has the following anatomy.

Its extent is marked by the outer edge of the anterior scalenus, G, on the one side, and the lower border of the first rib on the other (beneath the clavicle). The vessel is directed outwards at first, about an inch above the clavicle, and it passes downwards finally under the most prominent point of that bone.

Superficial to the artery are the common coverings of the space, viz., the skin, the subcutaneous fat with the platysma, and the deep fascia; and as it is about to pass under the clavicle the supra-scapular artery and vein cross in front. Underneath the vessel lie the middle scalenus, F, and the first rib.

Its companion vein, subclavian, is arched like the artery (Plate xviii.), but it is placed lower in the neck, and beneath the clavicle. Crossing the artery near the scalenus is the external jugular vein, *k*, whose branches may form a plexus over it.

The nerves of the brachial plexus, 11, lie above the artery near the scalenus anticus, and gradually approach it below, so that, at the clavicle, the trunk formed by the last cervical and first dorsal touches the vessel, and may be taken up in the operation of tying the subclavian. A small branch, 10, to the subclavius muscle is directed across the artery. Superficial to the clavicular space are the descending cutaneous branches of the cervical plexus, which must be cut in the operation for ligature.

Offsets of the artery. As a rule this part of the subclavian trunk does not furnish any named branch. A *cutaneous* offset, *d*, took origin from the vessel in this body, but it springs commonly from the supra-scapular artery, *b*, near the external jugular vein.

Compression of the artery. As the subclavian artery is uncovered by muscle whilst it crosses the triangular space, it may be compressed at the lower part of the neck during life. Its position is marked on the surface by the most prominent point of the clavicle; and if the thumb is pressed firmly downwards and backwards behind that point of the bone towards the first rib, the circulation in the vessel may be stopped. Sometimes the top of a key padded may be used more advantageously than the thumb.

Ligature of the third part of the subclavian artery is practised commonly for aneurism of the axillary trunk, and as this operation may be rendered more difficult by the unusual position of the subclavian vessels, and by unusual states of the surrounding parts, the conditions complicating it will be first reviewed.*

* The summary here made has been derived from the facts made known by

Alterations affecting the artery. Commonly the arch of the vessel rises about an inch above the clavicle (Quain), but it may be lowered to the level of, or sink beneath the bone; and on the other hand it may be elevated as high as one inch and a half above the collar bone. Occasionally the artery passes over or through the anterior scalenus, instead of beneath it. When the artery has either the higher level, or the more superficial position, it will be rendered less deep, and it will be more easy to find in an operation.

One or two branches for the shoulder, viz., posterior scapular and supra-scapular, may spring from this part of the artery. If such branch or branches should be seen in an operation, greater security against secondary hæmorrhage would be obtained by tying one or both, than by leaving either free to convey blood into or from the trunk near the ligature.

Alterations in the surrounding parts. With a thin and long neck and a flat clavicle, there is a prospect of a less tedious operation than in the opposite states of those parts, because the artery will be nearer the surface.

Muscular fibres may cover the artery as before said, p 137, the clavicular attachments of the sterno-mastoid and the trapezius being lengthened, or the omo-hyoid arising from the clavicle. Also in axillary aneurism high in the arm-pit the clavicle may be carried upwards considerably above the level of the subclavian artery. Under these circumstances the operation of ligature would be made more difficult, as the artery must be sought behind the raised bone in the one case, and beneath the muscular fibres in the other.

The subclavian vein rises sometimes as high as the level of the clavicle; and it has been found twice beneath the anterior scalenus with the subclavian artery: both changes in its position would cause it to be more endangered in the steps of an operation. The external jugular may be moved outwards from the sterno-mastoideus as far as the middle of the clavicle, so that it

Mr. Quain's researches on the surgical anatomy of the arteries, in the work before quoted.

and its branches would lie in the centre of an incision to reach the artery: this position of the vein may so interfere with the access to the artery as to render expedient division of the vein, and ligature of the ends.

Steps of the operation of ligature. Taking the most prominent part of the clavicle as the superficial guide to the position of the artery, draw down the loose skin of the neck, and cut for two inches and a half along the clavicle—the line of the vessel marking the centre of the cut—so as to divide on the bone the skin, the fat and the platysma, and the superficial nerves and vessels.* Let this cut be next moved rather above the clavicle, and let the operator divide the deep fascia, and find his way vertically downwards to the artery, looking out for the intermuscular interval between the trapezius and sterno-mastoideus, and that between the omo-hyoideus and clavicle, and dividing any muscular fibres which would interfere with his progress. After the muscles have been passed the surgeon proceeds cautiously, not letting the knife pass beneath the clavicle to wound the supra-scapular vessels or the subclavian vein, and using at this stage the outer, rather than the inner part of the wound. Towards the inner end of the incision the external jugular vein with branches will soon be met with, and it may be either drawn inwards, or divided and tied, according to the impediment it offers to reaching the artery.

To find the artery in the bottom of the wound, look to the outer end for the firm and white cords of the brachial plexus, which serve as the deep guide; and when these are recognised the artery will be found lower down, *i.e.* between them and the first rib.† After the artery has been laid bare by the removal of some fat and a slight sheath, the aneurism needle should be entered in the outer angle of the wound, where the handle may

* If such a superficial vessel as that marked, *d*, in the drawing, should arise from the subclavian trunk, division of it at this stage would be followed by considerable hæmorrhage, and ligature of it would probably be needed before the operation could be continued.

† The projection or tubercle on the first rib, at the attachment of the anterior scalenus muscle, is said by some authors to serve as the deep guide to the vessel, but this eminence is seldom prominent enough to be felt by the finger.

be depressed so as to make the point with the thread turn under the vessel.

Arterial branches. The smaller arteries laid bare in the dissection are derived from two arterial trunks. Behind the sterno-mastoid they are offsets of the subclavian or arm artery; and the branches in front of the muscle, or piercing it (except the lowest), spring from the carotid or neck artery.

The *supra-scapular artery*, *b*, comes from the first part of the subclavian trunk, and runs behind the clavicle with its vein to the upper border of the scapula: it ends on the dorsum of that bone.

An offset from the supra-scapular to the integuments arises near the sterno-mastoid: in this instance it comes from the third part of the subclavian, and is marked, *d*.

Transverse cervical artery, *c*. It arises in common with the preceding, and crossing the side of the neck above the arch of the subclavian artery, courses beneath the trapezius: here it furnishes a large branch (superficial cervical), and bends finally along the base of the scapula with the name *posterior scapular*, and supplies the muscles inserted into the vertebral border of that bone.

In the posterior triangle it gives many branches to the levator anguli scapulæ, to the lymphatic glands, and to the fat.

Two small arteries, *e* and *f*, are offsets of the *ascending cervical artery* (a branch of the subclavian): they are distributed to the muscles on the side of the neck, and to the areolar tissue and the glands of the triangular space.

The *posterior auricular artery*, *g*, issues in front of the sterno-mastoideus, and ascends to the back of the ear and the contiguous part of the head.

A cutaneous offset, *h*, courses over the sterno-mastoid muscle, and accompanies the small occipital nerve.

Perforating branches. After piercing the sterno-mastoid muscle these small arteries supply the platysma and the tegumenta.

SUPERFICIAL VEINS OF THE NECK.

In the neck there are two superficial or jugular veins, a lateral

and an anterior. Only the lateral vein and its branches appear in the dissection: the other is figured in Plate xvi.

k. External jugular vein.	*n.* Supra-scapular vein.
l. Transverse cervical vein.	*o.* A subcutaneous vein.

The *external jugular vein*, *k*, conveys blood from the head to the subclavian vein, and gathers blood also from the superficial parts of the neck. It begins in the parotid gland by the union of the temporal and internal maxillary veins (Plate xvii.); and becoming superficial, it descends beneath the platysma muscle, A, to the lower part of the neck, where it sinks through the fascia and ends in the subclavian vein (Plate xviii). Its common position in the neck would be marked by a line from the angle of the jaw to the middle of the clavicle, though in the Plate it is internal to that line.

At the upper part of the neck the vein is small in size, receiving only few branches, but for an inch and a half at the lower end, it is dilated behind the sterno-mastoid muscle: here it receives veins from the shoulder, viz. the transverse cervical, *l*, the supra-scapular *n*, and some cutaneous veins—one being marked with *o*. A pair of valves exists both above and below the lower dilatation. The lower pair is close to the clavicle, and is less complete than the other, for it allows blood to pass in a reflex course from the subclavian vein. The upper pair is found just after the vein crosses the sterno-mastoid muscle, and acts perfectly, as it permits the blood to flow only in one direction—from above down.

Bloodletting in the external jugular vein, is seldom had recourse to now, but the steps of the operation are the following:—The downward current of the blood is stopped by pressure of the thumb near the clavicle. A cut is then made obliquely upwards and backwards across the vein, incising the vein and the fibres of the platysma to the necessary extent. As long as the pressure on the vein remains the blood issues through the opening, but when the thumb is removed the flow stops because the blood finds its way by the usual channel into the subclavian. After the operation is finished the wound is to be closed by adhesive plaster.

Under some conditions air may enter the vein during the operation of bloodletting. As long as the blood runs freely, and the breathing is regular, the accident is not likely to happen: but if the breathing becomes laboured, or if the opening is not closed as soon as the flow of blood stops, air may be drawn into the vein.

In suspended animation the external jugular is sometimes opened with the view of relieving the over distended right side of the heart*; and this practice is founded on the fact that blood will enter the jugular below from the subclavian vein. At the same time the blood may flow downwards through the anterior jugular in the usual way (Plate xviii.), so as to relieve simultaneously the congested heart and head.

NERVES IN THE POSTERIOR TRIANGULAR SPACE.

Parts of the cervical and brachial plexuses of nerves, with one cranial nerve—the spinal accessory, are included in the dissection.

1. Third cervical nerve.
2. Fourth cervical nerve.
3. Great auricular nerve.
4. Small occipital nerve.
5. Superficial cervical nerve.
6. Superficial descending branches of the cervical plexus.
7. Nerve to the rhomboideus.
8. Nerve to the serratus magnus.
9. Branches to the trapezius.
10. Nerve to the subclavius.
11. Upper part of the brachial plexus.
12. Supra-scapular nerve.
13. Spinal accessory nerve.
14. Posterior auricular nerve.

† Nerve to the levator anguli scapulæ from the cervical plexus.

The *cervical plexus* is formed by the union of the upper four cervical nerves; and it lies beneath the sterno-mastoideus, B, and on the levator anguli scapulæ, E. Only the lower part of the plexus comes into the posterior triangular space, and from it spring muscular, and ascending and descending tegumentary branches.

Ascending branches.—These consist of the three following nerves, which are directed to the ear, the occiput, and the fore part of the neck.

* A more general employment of this practice is recommended by Dr. Struthers, in a paper "On Jugular Venesection in Asphyxia," Edin. Med. Journal for November, 1856.

The *great auricular nerve*, 3, courses near the external jugular vein to the lobe of the ear, and ends in the integuments of the hinder and outer parts of the pinna. One offset joins the posterior auricular nerve, 14, and others are directed forwards to the integuments over the parotid gland: some long slender branches pass through the parotid to join the facial nerve (Plate xvii.).

The *small occipital nerve*, 4, lies along the posterior border of the sterno-mastoideus, and perforating the deep cervical fascia near the head, ramifies in the scalp of the occipital region.

The *superficial cervical nerve*, 5, is often represented by several small nerves, as in the Drawing, and is therefore very variable in its size: it is distributed to the platysma, and to the integuments of the neck in front of the sterno-mastoid muscle.

Descending branches.—The chief of these, two or three in number, belong to the teguments of the shoulder and upper part of the thorax; but some offsets are directed backwards to the integuments over the trapezius muscle, from the clavicle nearly to the head.

A large nerve, 6, divides into three:—one crosses the attachment of the sterno-mastoideus to the clavicle, another lies over the insertion of the trapezius into the same bone, and the third crosses the middle of the clavicle; they extend two or three inches below the collar bone, the inner nerves reaching least far.

Muscular offsets.—Only a few of these are now visible. One, †, supplies the levator anguli scapulæ. Others, 9, pass beneath the trapezius supplying it; and they join beneath that muscle with the spinal accessory nerve, 13.

Brachial plexus.—The lower four cervical nerves and the first dorsal nerve (in part) give rise to the large bundles of nerves marked, 11; but in the side view presented to the artist the several nerves entering the plexus could not be shown as in Plate xviii.

The plexus extends under the clavicle to the axilla, where it terminates in nerves for the upper limb; and all the muscular offsets in the neck come from the fifth and sixth cervical nerves, with the exception of small branches to the longus colli and the scaleni.

The *nerve to the rhomboid muscle*, 7, pierces the fibres of the scalenus medius, and is inclined backwards beneath the elevator of the angle of the scapula.

Nerve to the serratus magnus, 8, (posterior thoracic). This nerve issues through the scalenus medius, below the preceding, and is continued beneath the cords of the plexus to the axilla. See Plate ii., 5.

The *nerve to the subclavius*, 10, passes in front of the subclavian artery to the under surface of its muscle.

The *supra-scapular nerve*, 12, accompanies the omo-hyoid muscle to the back of the scapula, and supplies the supra and infra-spinate muscles, the shoulder-joint, and the blade bone.

The two remaining nerves in this part of the neck belong to the cranial set.

The *spinal accessory nerve*, 13, (eleventh cranial) pierces the sterno-mastoideus, and ends in the trapezius, after crossing the posterior triangular space, where it joins the spinal nerves. Under the trapezius it communicates with the nerve marked, 9, before it enters the fleshy mass.

The *posterior auricular*, 14, a branch of the facial or seventh cranial nerve, ascends in front of the mastoid process, and being joined by the great auricular nerve, splits into two :—one piece belongs to the integuments of the back of the ear, and the retrahent muscle of the pinna ; and the other supplies the hinder belly of the occipito-frontalis muscle, and the integument contiguous to it.

Lymphatics.—Beneath the fascia lies a collection of cervical lymphatic glands in the clavicular part of the posterior triangle. They communicate below with the lymphatics of the axilla, and above with those about the ear and the occiput by means of the superficial lymphatic vessels and glands accompanying the external jugular vein. Beneath the sterno-mastoid they join also the deep glands by the side of the carotid vessels.

DESCRIPTION OF PLATE XVI.

THIS Plate exhibits a surface-view of the side of the neck, in front of a line from the mastoid process to the inner end of the clavicle.

Supposing the skin thrown aside as in the Figure, the thin fleshy fibres of the platysma will appear through a slight fatty covering, and may be readily cleaned. This muscle may then be raised towards the jaw by a cut over the sterno-mastoideus, the superficial veins and nerves being traced out at the same time. Before the removal of the deep fascia the subjacent muscles should be fixed in their natural position by stitches, to prevent their slipping out of place when the investing sheaths are taken away.

Afterwards the areolar tissue and fat are to be cleared out between the jaw and the hyoid bone, and from the whole surface of the space laid bare.

SURFACE VIEW OF THE FRONT OF THE NECK.

The prominent sterno-mastoid muscle, B, divides into two the side of the neck, and in front of it is a slight hollow, which is most marked near the jaw, and is wider above than below.

In front of the sterno-mastoid lie the elevator and depressor muscles of the hyoid bone,—the former extending downwards from the lower jaw, and the latter reaching upwards from the chest and shoulder.

Below the side of the jaw is the submaxillary gland, K, with a chain of small lymphatic glands reaching backwards to the sterno-mastoid muscle; and a lymphatic gland with a small artery entering it is lodged just above the body of the hyoid bone. Between the jaw and the ear the parotid gland, L, is wedged in.

No large arterial trunk can be seen on the surface of the neck as long as the sterno-mastoideus keeps its natural position ;* and this Plate teaches also that no triangular space containing the large cervical bloodvessels is observable until that muscle has been displaced, as in Plate xviij.

A few small arteries reach the surface. Thus, the facial artery, *a*, with its vein winds over the submaxillary gland and the jaw in front of the masseter muscle, and gives forwards the submental branch, *b*, below the jaw ; whilst opposite the back of the hyoid bone the lingual vessels, *c*, appear for a short distance. Issuing from beneath the sterno-mastoideus are small cutaneous offsets, *e*, of the upper thyroid artery—one, *d*, entering the superficial lymphatic gland near the hyoid bone ; and piercing the sterno-mastoideus are other cutaneous arteries, *f*, of the subclavian and external carotid trunks. Near the ear a cutaneous branch, *g*, of the posterior auricular artery, escaping beneath the parotid gland, crosses over the sterno-mastoideus.

Two superficial jugular veins are directed from above down through the anterior part of the neck. One the external jugular, *h*, crosses the sterno-mastoideus from before back ; and the other, the anterior jugular, *l*, lies in front of that muscle, and near the middle line of the neck.

Cutaneous nerves cross from behind forwards, spreading out over the region dissected. The nerve marked, 1, is the cervical part of the seventh cranial nerve, which reaches as low as the hyoid bone ; and the nerve, 2, is a branch of the cervical plexus to the teguments below the preceding.

MUSCLES AND THE CERVICAL FASCIA.

Most of the muscles laid bare will be described more fully in the explanation of the following Plate ; but as the natural state of the sterno-mastoideus, and its connection with the cervical

* Anatomists depict and describe the common carotid artery as uncovered by the sterno-mastoideus at its upper end. And the directions of surgeons for placing a ligature on that bloodvessel are based on the same inaccuracy.

fascia would be destroyed by the deeper dissection, these will be noticed below.

A. Platysma myoides, cut.
B. Sterno-cleido-mastoideus.
C. Thyro-hyoideus.
D. Omo-hyoideus.
E. Sterno-hyoideus.
F. Anterior belly of the digastric muscle.
H. Stylo-hyoideus.
J. Hyoid bone.
K. Submaxillary gland.
L. Parotid gland.
N. Process of the deep cervical fascia fixing the sterno-mastoideus.
† Lymphatic glands.

The *sterno-cleido-mastoid* muscle, B, incases somewhat the narrowed part of the neck by the elongation of its edges forwards and backwards. The anterior curved border is manifest in the Drawing, and it is kept in this position by a piece of fascia, N, which is attached to the lower jaw.

The muscle covers the carotid bloodvessels as high as the digastricus, and even when the head is thrown backwards.

In the operation of tying the common carotid artery the muscle would have to be dissected back for some distance before the line of the vessel is reached; and pressure on the artery must be made through the muscle. This fleshy covering gives protection to the large vessels, and these cannot be injured in wounds of the neck unless the muscle is cut.

Deep cervical fascia.—The special fascia of the neck invests the muscles with sheaths. Most of it has been removed in cleaning the muscles; but a strong process marked, N, has been left for the purpose of showing its connection on the one hand with the sterno-mastoideus, and on the other with the angle of the lower jaw. The office of this piece is to keep curved the anterior border of the sterno-mastoideus, for as soon as it is cut the edge takes a straight direction, as in Plate xvii.

CONNECTIONS OF THE SALIVARY GLANDS.

On each side there are three salivary glands in contact with the lower jaw. One is lodged behind the angle of the bone and is named parotid: another is partly covered by the side of the jaw —the submaxillary; and the third, the sublingual, lies beneath the front of the tongue.

The *parotid* is the largest of the salivary glands. It is wedged between the jaw in front, and the ear with the mastoid process and the sterno-mastoideus behind; and it projects downwards beyond the level of the jaw, where the process, N, of the cervical fascia separates it from the submaxillary gland.

Towards the surface the gland is flat, and is covered by the deep cervical fascia: on it rest one or more lymphatic glands. Its deep part is very irregular in form, and sends downwards prolongations around the styloid process.

Several vessels and nerves pass through the substance of the parotid, and the position of these may be studied in Plate xvii. The external carotid artery, *b*, ascends through the gland giving off the auricular, temporal, and internal maxillary branches. The external jugular vein, *r*, begins by the union of the temporal and internal maxillary branches, and passes downwards superficially to the carotid. The facial nerve, 4, traverses the gland from behind forwards, over the artery, and is joined by offsets of the great auricular nerve. Close to the ear the cutaneous part, 11, of the auriculo-temporal nerve is directed upwards by the side of the temporal artery.

The excretory duct of the gland (ductus Stenonis) leaves the fore part, and piercing the buccinator muscle, opens into the mouth opposite the second molar tooth of the upper jaw (Plate xx.).

In enlargement of this gland the swelling will project downwards at first towards the deep vessels and nerves in front of the spine, and then into the neck along the sterno-mastoideus; and extension towards the surface will be delayed by the strong fascia binding it down. Much pain will attend the swelling of the gland in "mumps" and other affections, as in all inflamed glandular parts that are prevented expanding by the firmness of the incasing sheaths.

The swelling and abscesses in front of the ear in scrofulous children are occasioned by inflammation of the lymphatic glands on the surface of the parotid.

The *submaxillary gland*, K, is not surrounded by such unyielding structures as the parotid; for, though concealed somewhat by

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the side of the maxilla, it projects down the neck for an inch or more in front of the angle of the jaw. Superficial to it are the integuments and the platysma with the deep fascia; and beneath it is the mylo-hyoid muscle. In front it is bounded by the anterior belly of the digastric, F; below by the digastric and the stylo-hyoid, H; and behind by the process, N, of the deep cervical fascia which intervenes between it and the parotid. Over the surface wind the facial vessels, *a*.

The gland consists of larger lobules than the parotid; and from its deeper surface the duct (Wharton's) is continued to the floor of the mouth: the course of the duct is evident in Plate xxii. of the submaxillary region.

The *sublingual gland* projects in the floor of the mouth under the front of the tongue, where it forms a lengthened swelling. Placed deeply under the side of the jaw, close to the symphysis, its connections will be indicated in Plate xxii.

The *lymphatic glands* marked thus, †, are three or four in number, and lie along the base of the jaw, superficial to the sub-maxillary gland: they receive vessels from the submental artery, *b*. In scrofulous children these glands may enlarge, and suppurate.

In the middle line, just above the hyoid bone, is a small lymphatic gland, which receives a vessel, *d*, from the upper thyroid artery.

SUPERFICIAL ARTERIES OF THE NECK.

In comparison with the superficial veins the arteries ramifying on the surface are few, and are small in size. None except the facial, *a*, and the lingual, *c*, are large enough to furnish serious hæmorrhage in superficial wounds; but in cuts involving the muscles, the large trunks displayed in Plate xvii may be opened.

a. Facial artery and vein.
b. Submental branch of the facial.
c. Lingual artery and vein.
d. Offset of the upper thyroid artery to a lymphatic gland.
ee. Superficial offsets of the upper thyroid artery.
ff. Branches of the subclavian and carotid trunks perforating the sterno-mastoideus.
g. Cutaneous offset of the posterior auricular.

The anatomy of the several arteries will be given with the description of Plate xvii.

SUPERFICIAL VEINS OF THE NECK.

Two superficial jugular veins, and the facial and lingual veins, appear in this dissection.

h. External jugular vein.
l. Anterior jugular vein.
n. Facial vein.

The *external jugular* vein, *h*, is figured in the part of its course which is superficial to the deep fascia of the neck, and is concealed by the platysma muscle, A, (p. 143).

The *anterior jugular* vein, *l*, begins in the teguments below the chin, and communicates with a branch of the facial vein. Lying superficially near the anterior edge of the sterno-mastoideus, it sinks through the cervical fascia near the sternum, and opens into the subclavian vein (Plate xviii.). It unites commonly with the external jugular.

CUTANEOUS NERVES OF THE FRONT OF THE NECK.

The facial nerve and branches of the cervical plexus supply the superficial structures of the neck.

1. Cervical part of the facial nerve.
2. Superficial cervical nerve.
3. Great auricular nerve.

The *infra-maxillary* branch, 1, of the facial nerve, issuing from beneath the parotid, sends forwards offsets beneath the platysma as low as the hyoid bone: it supplies that muscle and the integuments.

The *superficial cervical nerve*, 2, is bent forwards under the platysma, and its branches pierce the muscle to supply the integuments between the hyoid bone and the sternum. Above, it joins the facial nerve, and it is said to give offsets to the lower part of the platysma.

The *great auricular nerve*, 3, ascends by the side of the external jugular vein to the ear, and ends as before said (p. 145).

DESCRIPTION OF PLATE XVII.

THE anterior triangular space of the neck, as it appears after displacement of the sterno-mastoid muscle, is shown in this Figure.

The skin being reflected forwards as in the Drawing, the platysma muscle may be denuded at the same time ; and this muscle and the deep cervical fascia should be then raised. Afterwards the parotid gland is to be picked out of the hollow between the ear and the jaw, and the areolar tissue and the fat are to be removed from the space without injury to the numerous vessels and nerves.

ANTERIOR TRIANGULAR SPACE.

This intermuscular space corresponds with the surface-depression between the jaw and the sternum, and contains the carotid bloodvessels with their companion veins and nerves, and some salivary and lymphatic glands.

Triangular in form, with the base upwards, it is bounded in the following way. Behind is the reflected sterno-mastoideus with the ear ; and in front the space reaches to the middle line of the neck. At the base lies the jaw-bone ; and the apex touches the top of the sternum.

Stretched over the hollow are the teguments, with the platysma muscle and the deep cervical fascia ; and in the floor the air and food passages are lodged, covered by the muscles of deglutition.

The depth increases from below upwards, and it is greatest along the upper two thirds of the sterno-mastoideus and the front of the ear, where the great vessels and nerves are placed ; but it diminishes gradually towards the front.

Along the middle of the neck lie certain well-marked prominences, which can be felt readily by the finger during life, and serve as guides in operations on the vessels and the windpipe. About two inches from the lower jaw, when this is raised, projects

the narrow firm line of the hyoid bone, which is marked, J, in the preceding Plate. A finger's breadth below that bone the prominence of the thyroid cartilage of the larynx (pomum Adami) is met with. Still lower, about half an inch, comes the firm cricoid or ring cartilage of the larynx,—a prominence less than the former; and between the two is a slight hollow, opposite the crico-thyroid membrane, through which the knife is sunk in the operation of laryngotomy. From this point to the sternum the tube of the windpipe and the thyroid body carry forwards the muscles: the former can be recognised by the finger.

Behind the os hyoides and the larynx and trachea lies the pharynx with the œsophagus.

Position of arteries. Opposite the level of the cricoid cartilage the large trunk of the common carotid, *a*, escapes from beneath the depressor muscles of the hyoid bone. In company with the internal jugular vein it lies between the pharynx and the spine, and ascends under cover of the sterno-mastoideus, A, to the upper border of the thyroid cartilage, where it splits into the external carotid, *b*, and internal carotid, *c*. From the point of division these two arteries are continued in the direction of the parent trunk to the interval between the ear and the jaw, and they end in the following way:—one (external) is consumed in offsets outside the cavity of the skull; and the other (internal) is distributed chiefly to the brain, without furnishing branches to the neck. Neither vessel is visible till after the sterno-mastoideus has been displaced. See Plate xvi.

Position of veins. By the side of the common carotid artery is the internal jugular vein, *p*, and it is continued to the base of the skull along the internal carotid trunk. In the upper narrowed part of the space between the jaw and the ear the external jugular vein begins; but it then runs downwards over the sterno-mastoideus. Near the middle line of the neck the anterior jugular vein, *s*, descends (Plate xvi.); and it passes beneath the sterno-mastoideus at the lower part of the neck.

Position of nerves. Many nerve trunks lie in contact with the great bloodvessels, and most of them accompany those vessels to the base of the skull.

Superficial to the sheath of the vessels at the spot where the common carotid is tied, is the descendens noni nerve, 3. A little above the hyoid bone the hypoglossal nerve, 14, is directed forwards over both carotid arteries; and in front of the ear the ramifications of the facial nerve, 4, cross over the external carotid.

On a line with the base of the jaw-bone the glosso-pharyngeal nerve is inclined inwards between both arteries.

In the sheath, between and parallel with the vein and artery, the vagus nerve extends through the neck (Plate xxiv.); two of its branches, the superior laryngeal, 1, and the external laryngeal, 2, being directed inwards to the larynx.

Beneath the sheath the cord of the sympathetic nerve (Plate xxiv.) rests on the spinal column.

External or posterior to the sheath for a short distance is the spinal accessory nerve, 13, as this issues from beneath the digastric muscle, R.

One small nerve is altogether removed from the sheath: it is the mylo-hyoid branch, 12, of the inferior maxillary nerve (Plate xxi.), and escapes from under the jaw-bone.

Glands of the space. Two large salivary glands, the parotid and submaxillary, which are seen in Plate xvi., where they are marked L and R, occupy the base of the triangular space.

The lymphatic glands have been cleared away in the dissection: one set lies along the jaw-bone (Plate xvi.); and the other (deep cervical) is placed along the side of the jugular vein, under the sterno-mastoideus.

MUSCLES OF THE FRONT OF THE NECK.

The muscles occupying the upper and fore parts of the space converge to the os hyoides—the upper set elevating, and the lower set depressing that bone.

A. Sterno-mastoideus.
B. Stylo-hyoideus.
C. Omo-hyoideus—anterior belly.
D. Sterno-thyroideus.
F. Thyro-hyoideus.
H. Digastricus—anterior belly.
N. Hyo-glossus.
P. Stylo-hyoideus.
R. Digastricus—posterior belly.
S. Masseter.

Depressors of the os hyoides. These muscles cover the trachea and larynx, and are marked B, C, and D.

Omo-hyoideus, C. The anterior belly of this muscle crosses the common carotid artery and jugular vein just below the cricoid cartilage, and is inserted into the body of the hyoid bone close to the great cornu. For the posterior belly, see Plate xv. and p. 133.

Sterno-hyoideus, B. The muscle arises from the inner surface of the sternum and first rib, and is inserted into the centre of the body of the hyoid bone.

Sterno-thyroideus, D, arises lower in the chest than the preceding, though like it from the sternum and the rib, and is inserted into the oblique line on the thyroid cartilage, where it is continuous with the following.

The small *thyro-hyoideus*, F, joining the preceding below, is inserted into the anterior half of the great cornu, and into part of the body of the os hyoides.

This group of muscles is covered partly by the sterno-mastoideus; and it conceals the windpipe and the thyroid body, and the sheath of the great bloodvessels. An interval separates the muscles of opposite sides along the middle line of the neck, except for about an inch above the sternum, where the sterno-thyroid muscles touch.

Action. Commonly the muscles act from the sternum, and draw down rapidly the os hyoides as soon as the morsel of food or the fluid to be swallowed has passed the upper aperture of the larynx. If they take their fixed point above, the sterno-hyoid and sterno-thyroid will assist in dilating the chest in laborious breathing; and the small thyro-hyoid, F, will raise and tilt backwards the thyroid cartilage—relaxing thereby the vocal cords.

Elevators of the hyoid bone. These muscles are more numerous than their antagonists, for some extrinsic muscles of the tongue help to raise the os hyoides: the deeper muscles of the set may be referred to in Plate xxii.

Stylo-hyoideus, P. Arising near the root of the styloid process, the muscle is divided into two parts, between which passes the tendon of the posterior belly, R, of the digastricus; and it is

inserted into the body or the great cornu of the os hyoides, joining the aponeurosis of the digastricus.

The *digastric* muscle consists of two fleshy parts with an intermediate tendon.

The posterior belly, R, is fixed to the groove beneath the mastoid process of the temporal bone; and the anterior, H, is attached to the jaw close to the symphysis. Below, the muscle is connected to the surface of the body of the hyoid bone by a thin aponeurosis, which joins the anterior belly and the fore part of the tendon.*

The digastric encloses with the jaw a space in which the two superficial salivary glands are lodged. And the posterior belly marks the spot at which the carotid bloodvessels become deep and inaccessible: the position of this part of the muscle corresponds with a line on the surface from the mastoid process to a point half an inch above the hyoid bone.

The *mylo-hyoid* muscle drops from the jaw-bone to the body of the os hyoides: it lies beneath the anterior belly of the digastric, and in Plate xxii., where it is reflected, it may be seen to join its fellow along the middle line of the neck.

The *genio-hyoideus* is beneath the preceding. Plate xxii. shows it in position, reaching from the jaw to the hyoid bone.

Two tongue muscles—*hyo* and *genio-glossus*—may act as elevators of the hyoid bone: the hyo-glossus is marked with N in the Figure, and both are displayed fully in Plate xxii.

Action of the elevators. With the mouth shut and the tongue fixed against the roof, the muscles will assist in preparing the pharynx for the reception of the food, by drawing upwards and forwards the os hyoides, so as to bring the larynx under shelter of the tongue. But if the mouth is open and the tongue not in contact with the roof, the muscles are deprived of their usual point of support above, and swallowing will be performed with difficulty; —the necessary elevation of the hyoid bone in this imperfect deglutition being then dependent upon the stylo-hyoideus and

* There are great variations with respect to this attachment and the state of the stylo-hyoideus muscle: some of these may be perceived in the different Plates.

posterior belly of the digastricus, which have their usual arrangement, and on the extreme contraction of the other muscles.

Supposing the os hyoides fixed by its depressors, the muscles used commonly as elevators of that bone will have a different action:—those attached to the jaw may then carry downwards that bone, so as to open the mouth; and the lingual muscles can depress the tongue.

ARTERIES OF THE FRONT OF THE NECK.

Only the carotid trunks and some branches of the external carotid artery are visible in front of the sterno-mastoideus.

a. Common carotid artery.
b. External carotid artery.
c. Internal carotid artery.
d. Superior thyroid artery.
e. Lingual artery.
f. Facial artery.
g. Occipital artery.
h. Posterior auricular artery.
l. Superficial temporal artery.
n. Internal maxillary artery.
× Spot for ligature of the common carotid artery.

The *common carotid* trunk, *a*, begins opposite the sterno-clavicular articulation, and ends at the upper edge of the thyroid cartilage by splitting into two—external and internal carotid. Its situation will be marked by a line on the surface from the inner end of the clavicle to a point mid-way between the jaw and the ear.

Contained in a sheath of fascia with the jugular vein and the vagus nerve, it is covered throughout by muscles; and it has the following connections with the contiguous parts:—Superficial to it, besides the teguments and the platysma, are the depressors of the hyoid bone and the sterno-mastoideus—the last muscle covering it to the ending (Plate xvi.), and the others, only as high as the cricoid cartilage. Beneath the vessel is the spinal column. To its inner side lie the gullet and the air passage, with the thyroid body; and as the trachea swells out to form the larynx, necessarily the artery is carried farther from its fellow above than below. Along the outer side is a chain of lymphatic glands, which is liable to become enlarged.

The internal jugular vein, *p*, is parallel to, and in close contact

externally with the artery; and on the left side the vein advances over it, especially lower in the neck. Three veins cross the artery;—near the chest is the anterior jugular vein, *s*; near the ending the upper thyroid vein; and below the ×, the middle thyroid vein.

In front of the sheath, for the upper half, the descendens noni nerve, 3, crosses obliquely from without inwards. Beneath the sheath is the sympathetic nerve; and lower down the recurrent laryngeal nerve and inferior thyroid artery cross inwards under it. In the sheath, between the artery and vein lies the vagus nerve.

No collateral offset arises commonly from the carotid artery, and the trunk remains nearly of the same size; but not unfrequently the upper thyroid branch *d* is transferred to the slight dilatation at the end.

Ligature of the vessel. The part of the common carotid marked thus × is selected for ligature because it is far removed from each end, and because it is less deep here than at a lower point. But since the vessel may bifurcate as low as the cricoid cartilage or even lower, two trunks instead of one may be met with at this spot. Should the point of splitting of the artery be recognised in the operation of ligature both trunks may be tied; but if the origin of the two trunks cannot be seen in consequence of the artery having divided very soon, the finger may be pressed on each, and that trunk may be tied which is connected with the disease or injury for which the operation was undertaken (Quain).

Steps of the operation. With the line of the vessel in mind, the operator places the fore finger of the left hand opposite the cricoid cartilage, and makes an incision in that line three inches in length—the finger marking the centre—through the integuments, platysma, and deep fascia, down to the fibres of the sterno-mastoideus: should the cut be made too far forwards, the anterior jugular vein may be injured. Next the sterno-mastoid muscle is to be dissected back rather beyond the position of the artery, the head being inclined towards the shoulder of the same side to relax the fibres. The operator now looks for the deep guide, viz., the angle formed below by the omo-hyoid muscle, C, and the sterno-mastoideus, A, and seeks the vessel at that spot, dissecting but

As high as the mastoid process the artery is covered by the sterno-mastoideus A, the digastricus R, and the stylo-hyoideus, P, besides the common investing superficial layers; and thence to its ending it is concealed by the parotid gland (Plate xvi.). Anterior to it are the pharynx and the jaw; and beneath it is the styloid process. No companion vein belongs to this artery.

Several nerves cross this carotid trunk:—superficial to it near the beginning is the hypoglossal nerve, 14, and near the ending the ramifications of the facial nerve, 4; whilst beneath it lie the external laryngeal, 2, the superior laryngeal, 1, and near the jaw the glosso-pharyngeal (Plate xxii.).

The offsets of the artery are numerous:—they consist of an anterior set of three, viz., thyroid, *d*, lingual, *e*, and facial, *f*; a posterior set of two, occipital, *g*, and posterior auricular, *h*; and an ascending set, also three in number, the temporal, *l*, internal maxillary, *n*, and ascending pharyngeal (Plate xxiv.).

Ligature. The artery is accessible below the digastric muscle, and here it is covered, like the internal carotid, by the sterno-mastoideus. Its branches are attached to the trunk so thickly as not to leave space enough between any two for the application of a ligature without the prospect of hæmorrhage when the thread comes away. Before the removal of tumours about the jaw, ligature of the external carotid trunk might be considered advisable as an auxiliary means of checking hæmorrhage during an operation.

In a wound of a branch of the external carotid the vessel should be tied, as a rule, where it is injured; but in hæmorrhage from the artery of the tongue, where the bleeding orifice cannot be secured, the surgeon may have recourse to ligature of the artery nearer the origin from the common trunk.

Branches of the carotid. The *upper thyroid*, *d*, ends in the thyroid body: it gives offsets to the contiguous muscles, and a laryngeal branch to the interior of the larynx with the upper laryngeal nerve, 1.

The *lingual* artery, *f*, is distributed to the tongue. Arising above or below the cornu of the hyoid bone it is directed inwards

beneath the hyo-glossus muscle N. In the tongue the arteries of opposite sides converge to the tip (Plate xxii.).

If this artery is to be tied it may be secured between the origin and the edge of the hyo-glossus muscle, as it crosses on or near the cornu of the hyoid bone. An incision directed downwards and backwards over the cornu of the os hyoides would allow the artery to be laid bare: the hypoglossal nerve is a valuable guide to the position of the vessel in the bottom of the wound.

The *facial* artery, *f*, comes off near the digastricus, and courses under it and the stylo-hyoideus, but over the submaxillary gland. It supplies branches to the surrounding parts, and a *submental* offset below the jaw.

As it crosses the jaw it lies in front of the masseter, where it is covered by the platysma: it can be easily compressed with the finger in that situation.

The *occipital* artery, *g*, begins near the digastric muscle, and is directed beneath it to the occiput: the hypoglossal nerve hooks round the vessel when this arises low down. One or more offsets enter the sterno-mastoideus.

The *posterior auricular*, *h*, springs near the upper border of the digastricus, and runs to the back of the ear. A cutaneous offset passes to the occiput.

Temporal and *internal maxillary*. The maxillary, *n*, courses beneath the jaw, and it will be met with in other dissections. The temporal, *l*, ascends to the side of the head, and gives offsets to the ear: anteriorly it supplies a large branch to the face—*transverse facial*.

VEINS OF THE FRONT OF THE NECK.

Three in number, the veins are named jugular—internal, external, and anterior; and they return to the chest the blood circulated through the head and neck by the carotid arteries.

p. Internal jugular vein.
r. External jugular vein.
s. Anterior jugular vein.

The *internal jugular* vein, *p*, reaches from the foramen jugulare

in the base of the skull to the inner end of the clavicle, where it joins the subclavian vein (Plate xviii.). In the neck it is the companion vein to the common, and the internal carotid artery; and it is joined by the veins corresponding with the branches of the external carotid, with the exception of three which enter the external jugular.

External jugular, r. The course and ending of this vein have been before described (p. 143). In the Drawing the beginning of the vein by the union of the temporal and internal maxillary may be perceived: into the vein the posterior auricular branch is received lower down.

NERVES OF THE FRONT OF THE NECK.

Several cranial nerves appear in the region dissected; and they are distributed to the face, the tongue, the windpipe, and the gullet. Only one spinal nerve is seen.

1. Upper laryngeal nerve.
2. External laryngeal nerve.
3. Descendens noni nerve.
4. Facial nerve.
5. Temporo-facial piece of the facial nerve.
6. Cervico-facial piece of the facial nerve.
7. Nerve to the digastric and stylo-hyoid muscles.
8. Posterior auricular nerve.
9. Branches of the great auricular nerve joining the facial.
10. Great auricular nerve.
11. Auriculo-temporal branch of the fifth nerve.
12. Mylo-hyoid branch of the fifth nerve.
13. Spinal accessory nerve.
14. Hypoglossal nerve.

The *facial* nerve, 4, issuing from the skull by the stylo-mastoid foramen, divides into two chief parts, — temporo-facial, 5, and cervico-facial, 6: these pass forwards through the parotid gland to the forehead, the face, and the superficial parts of the neck as low as the hyoid bone.

As soon as the nerve leaves its bony canal it gives off the posterior auricular nerve, 8, and a muscular branch, 7, to the posterior belly of the digastricus and the stylo-hyoideus.

It is chiefly a motor nerve; and it gives the power of contracting to the superficial muscles of the head, ear, face, and neck.

It joins freely with the sensory fifth nerve, and furnishes offsets also to the integuments ; and as it supplies alone the posterior belly of the digastricus and the stylo-hyoideus, it must confer on them sensibility as well as motor power.

The *hypoglossal* nerve, 14, is a motor nerve of the tongue. Descending through the neck with the great bloodvessels till it comes below the digastric muscle, it is then directed forwards over the carotids to the submaxillary region : it will be continued in Plate xxii.

As it crosses the vessels it supplies two offsets :—one, *descendens noni*, 3, enters the depressor muscles of the hyoid bone, after joining with the spinal nerves (Plate xxiv.) ; the other, much smaller, ends in the thyro-hyoideus, F.

Branches of the vagus. Two branches of this nerve, viz., the upper laryngeal, 1, and the external laryngeal, 2, (an offset of the first) are furnished to the larynx ; their distribution will be referred to more fully in the description of the Plate of the larynx.

Branches of the fifth nerve. The *auriculo-temporal*, 11, is a sensory nerve, and ascends with the temporal artery to the side and top of the head : it supplies the ear with the attrahent muscle, and the parotid gland. The *mylo-hyoid* branch, 12, lies below the jaw, and ends in the anterior belly of the digastricus, and the mylo-hyoideus : contractility and sensibility are given to those muscles by the nerve.

The *great auricular* nerve, 10, of the cervical plexus is displayed in Plate xvi. In this Figure the communicating branches, 9, through the parotid to the facial nerve are brought into view.

DESCRIPTION OF PLATE XVIII.

THE dissection of the subclavian bloodvessels with the contiguous nerves and muscles is pourtrayed in this Plate.

This view may be prepared by cutting through the sterno-mastoid muscle, after the dissection of the posterior triangular space; and by sawing through the clavicle and removing the inner end. On the section of the clavicle the shoulder falls back, and the subclavius and omo-hyoideus muscles are stretched.

MUSCLES OF THE SUBCLAVIAN REGION.

Only the subclavius, the posterior belly of the omo-hyoideus, and the anterior scalenus will be now referred to, the other muscles having been described in other dissections.

A. Pectoralis major, cut.
B. Intercostal muscles of the first space.
C. Subclavius muscle.
D. Omo-hyoideus-posterior belly.
E. Omo-hyoideus-anterior belly.
G. Sterno-hyoideus.
H. Sterno-thyroideus.
J. Sternal part of the sterno-mastoideus.
K. Clavicular part of sterno-mastoideus, cut.
L. Anterior scalenus.
N. Middle scalenus.

Anterior scalenus, L. The connections of the muscle may be here studied: the attachments are given at p. 134. It lies beneath the sterno-mastoid and omo-hyoid muscles; and it is connected with the following vessels and nerves. In front of it lies the subclavian vein, *p*, with the external jugular, *s*, and anterior jugular, *v*; and along the inner edge descends the large internal jugular vein, *r*. Beneath it is the subclavian artery, *b*; and on it are three small arteries, supra-scapular, *l*, transverse cervical, *h*, and ascending cervical, *f*. Issuing from beneath the muscle are the large cervical nerves; and running down in front of it is the phrenic nerve, 3.

Omo-hyoideus, B. The posterior belly of this muscle is attached behind to the upper border of the scapula, and ends in front in a tendon beneath the sterno-mastoideus. It receives a small vessel from the supra-scapular, and a nerve from the descendens noni; and the supra-scapular vessels, *l* and *w*, and the supra-scapular nerve, 9, course backwards with it. See also Plate xv., and p. 133.

Subclavius muscle, C. In Plate ii. this may be viewed in its natural state, surrounded by a sheath of fascia. It arises from the first rib where the bone and cartilage join; and it is inserted into the grooved under surface of the clavicle. The inner part of the muscle shows a ragged edge, where it was detached from the bone.

THE SUBCLAVIAN ARTERY AND ITS BRANCHES.

The subclavian artery runs through the lower part of the neck, and gives branches to the chest, the shoulder, the neck, and the brain.

a. First part of the subclavian trunk.
b. Third part of the subclavian.
c. Common carotid artery.
d. Inferior thyroid artery.
f. Ascending cervical artery.
h. Transverse cervical artery.
l. Supra-scapular artery.
n. Internal mammary artery.

The *subclavian* artery of the right side begins opposite the inner end of the clavicle, where the innominate trunk bifurcates, and ends at the lower border of the first rib by becoming axillary. Between those points the artery forms an arch with the convexity upwards, which lies between the scaleni muscles. Its numerous connections will be best learnt by dividing the trunk of the artery into three parts:—one inside, one beneath, and one outside the anterior scalenus.

The *first part* of the artery, *a*, is concealed by the muscles of the front of the neck, viz., sterno-mastoideus, J, sterno-hyoideus, G, and sterno-thyroideus, H; also by the integuments and the platysma. It lies deeply, but not in contact with the spinal column.

Lying near the chest and below the artery is the arch of the

subclavian and innominate veins; and crossing it at right angles is the internal jugular vein, *r*, with the vertebral vein beneath this. And in front of the artery though separated by muscles is the anterior jugular vein, *v*.

The vagus nerve, 10, crosses over the artery inside the jugular vein, together with some branches of the sympathetic; and the recurrent branch of the vagus, and the cord of the sympathetic, lie beneath it (Plate xxiv.).

The *second* or *middle part* of the artery, the shortest and highest, is covered by the anterior scalenus, L, and the sterno-mastoideus, K; and rests on the middle scalenus, N.

No vein touches the artery in the second part, for the anterior scalenus separates the subclavian vein. Two arteries, transverse cervical, *h*, and supra-scapular, *l*, lie near the line of the subclavian trunk, the former being rather above, and the latter below it.

The lower cervical nerves are above the vessel between the scaleni; and the phrenic, 3, crosses it, but separated by the scalenus anticus.

The *outer* or *third part*, *b*, is the most superficial, and descends over the first rib to the axillary space, crossing beneath the omo-hyoideus, D, the subclavius, C, and the clavicle. This part appears in the posterior triangular space of the neck (Plate xv.); and its connections are described in p. 137.

Into the concavity of the arch of the bloodvessel the bag of the pleura projects, for this membrane rises above the first rib, and comes in contact with the first and second parts of the subclavian artery: this connection of the serous membrane must be remembered when ligature of the second part of the artery is to be undertaken. Alterations affecting the arch have been dwelt on in p. 140.

Number and *position of the branches.* Usually four branches arise from the artery in the following manner:—three are connected with the first part, and one with the second part; whilst no branch, as a rule, comes from the third part. Very commonly however (Quain) an offset (posterior scapular) of the branch, *h*, is attached to the last part of the subclavian trunk.

From the position of the branches, the connections, and the difference in the depth of the ends of the subclavian trunk, the third or external part, *b*, will be best suited for ligature on account of its comparative freedom from any branch, and its easily accessible position. As the second part gives origin commonly to but one branch it may admit of being tied under some circumstances. Whilst the inner or first part is so beset by branches as not to possess commonly an interval sufficient for the application of a ligature without secondary hæmorrhage. On the left side the connections forbid the attempt to put a thread on the first part.

Ligature. The steps of the operation for securing the artery in the third part, or beyond the scalenus, have been detailed at p. 141.

Should the less usual operation of tying the second part of the artery be resorted to, the clavicular piece of the sterno-mastoideus and the anterior scalenus would have to be cut through. In dividing the scalenus great care should be taken of the phrenic nerve, 3, on its front. Ordinarily the external jugular vein lies outside the scalenus: with the position here taken it would need to be cut through, and the ends would require to be then tied.

Branches of the subclavian artery. At their origin the branches are concealed by the jugular vein and the anterior scalenus, but in Plate xxiv. most may be seen. From the first part come the vertebral, the thyroid axis, and the internal mammary; and from the second part, the upper intercostal, with a small branch to the spinal canal (Quain).

1. The *vertebral* is the first branch, and ascends to the brain through the apertures in the six upper cervical vertebræ.

2. The *thyroid axis*, a short thick trunk, splits into the three following:—*Inferior thyroid, d.* This is a tortuous artery, and ends in the thyroid body: an offset, the *ascending cervical, f*, lies between the anterior scalenus and the larger anterior rectus, supplying offsets to both, and to the spinal canal. The *transverse cervical, h*, crosses the scalenus, and ends under the trapezius by dividing into two. The *supra-scapular, l*, courses along the clavicle to the scapula, on the dorsum of which it ramifies.

3. The *internal mammary*, *n*, arises opposite the vertebral and beneath the jugular vein: it enters the thorax through the upper opening, and is continued to the wall of the abdomen.

4. The *superior intercostal* (intercosto-cervical) arises under the scalenus: it supplies offsets to the upper two intercostal spaces; and a large branch to the back of the neck (deep cervical), which is delineated in Plate xix.

SUBCLAVIAN AND JUGULAR VEINS.

The veins of the arm and of the same side of the neck meet at the top of the thorax, and blend in one large trunk—the innominate: the limb vein is called subclavian, and the neck veins jugular.

p. Subclavian vein.
r. Internal jugular vein.
s. External jugular vein.
t. Transverse cervical vein.
v. Anterior jugular vein.
w. Supra-scapular vein.

The *subclavian* vein, *p*, is rather shorter than its corresponding artery, and ends near the inner border of the scalenus by joining the internal jugular to form the innominate trunk. Arched like the artery, it is placed in front of the scalenus, and commonly below the level of the clavicle. Valves exist in the trunk outside the place of entrance of the external jugular, *s*.

The veins joining it are the external and anterior jugular, and the vertebral. At the back of the vein, near the internal jugular, the right lymphatic duct opens; and at a similar spot on the left side the thoracic duct is received.

External and *anterior jugular veins*. The ending of these veins is seen in this Plate, and their course is described in p. 143. The external jugular, *r*, receives the transverse cervical branch, *t*, and the supra-scapular, *w*, and joins the subclavian vein outside the scalenus anticus. The anterior jugular, *v*, enters either the subclavian vein or the external jugular: when this vein is a tributary to the external jugular it wants valves (Struthers).

Internal jugular vein, *r*. The lower dilatation of the vein is

laid bare. Before its junction with the subclavian it is narrowed, and at the less wide part is a pair of valves to prevent the blood rushing backwards to the neck.*

The *innominate* is the large venous trunk formed by the union of the subclavian and internal jugular veins : it enters the chest, and joins with its fellow in the upper cava. The connections of the vein in the neck may be studied in the Figure.

NERVES OF THE SUBCLAVIAN REGION.

Most of the nerves are continued to distant parts, only two being distributed to the near muscles.

1. Great auricular nerve.
2. Superficial cervical nerve.
3. Phrenic nerve.
4. Descendens noni nerve.
5. Fifth cervical nerve.
6. Sixth cervical nerve.
7. Seventh cervical nerve.
8. Eighth cervical nerve.
9. Supra-scapular nerve.
10. Vagus nerve.

† Nerve to the subclavius.

The *diaphragmatic* (phrenic) nerve, 3, springs from the fourth spinal nerve in the cervical plexus, and is sometimes connected with the fifth spinal as it passes by that trunk. In the neck it courses over the anterior scalenus muscle, crossing from the outer to the inner edge ; and entering the chest beneath the innominate vein, it is transmitted through that cavity to the diaphragm. It is the motor nerve of the diaphragm.

Descendens noni nerve, 4. For the beginning of this branch of the hypoglossal, see Plate xvii. At the lower part of the neck it ends in branches for the sterno-hyoideus, G, sterno-thyroideus, H, and the posterior belly of the omo-hyoideus, D, as well as the anterior belly of the same muscle.

Brachial plexus. The lower four cervical nerves, 5, 6, 7, 8, join with the first dorsal to form the plexus. The branches of the plexus above the clavicle are enumerated in p. 146 ; but only

* These valves were first described by Dr. Struthers. See an account of them in the Edinb. Med. Journal for Nov. 1856, p. 241.

two, nerve to the subclavius, †, and the supra-scapular, 9, are seen in a front-view of this region.

The *vagus nerve*, 10, passes through the neck and thorax to the belly. At the lower part of the neck, on the right side, it occupies the interval between the jugular vein and the carotid artery, and crosses over the subclavian artery but beneath the innominate vein.

It furnishes a small cardiac branch near the subclavian artery; and close below that vessel it sends backwards the recurrent or inferior laryngeal nerve.

DESCRIPTION OF PLATE XIX.

A VIEW of the deep muscles, and of the vessels and nerves at the back of the neck, is here given.

After the integuments and the superficial muscles have been reflected the complexus is to be divided near the head; and the last muscle being thrown down and out, the vessels and nerves are to be sought in the dense tissue and fascia in which they are imbedded. Lastly, the muscles are to be defined.

DEEP MUSCLES OF THE NECK.

Extensor and rotator muscles of the head and neck lie beneath the complexus B. Between the head and the first two vertebræ, and corresponding with the interspinales, are placed the recti muscles; and laterally come two other small muscles, the obliqui. Occupying the vertebral groove is the semispinalis colli.

A. Sterno-mastoideus.
B. Complexus cut through.
C. Semispinalis colli.
D. Obliquus inferior.
F. Obliquus superior.
G. Rectus posticus major.
H. Rectus posticus minor.

The *complexus muscle*, B, is attached by the outer edge to the

transverse processes of the upper dorsal vertebræ, and to the articular processes of the cervical vertebræ, except the first two ; and by the inner edge it is connected with the spines of one or two lower cervical and upper dorsal vertebræ. It is inserted into the mid part of the occipital bone between the curved lines.

Towards the inner edge a piece of the muscle possesses a middle tendon, and this is often described separately as the *biventer cervicis.*

If the muscles of both sides act they will maintain the head erect, or will bring it back (raising the face) according to the degree of contraction ; but supposing only one to be concerned actively, the occiput will be inclined down and out towards the transverse processes of the same side.

Semispinalis colli, C. Filling the vertebral groove with the multifidus spinæ, it is attached externally, like the preceding muscle, to the transverse processes of the upper dorsal vertebræ, and to the articular processes of the cervical vertebræ, except the first three ; and internally it is inserted into the spines of the cervical vertebræ below the first.

Acting with its fellow it extends the spine : by itself, it rotates the spine, turning the face to the opposite side.

The *obliquus inferior*, D, slants between the first two vertebræ : it arises from the spine of the axis, and is inserted into the transverse process of the atlas.

Drawing backwards the lateral part of the atlas it rolls this bone round the odontoid process of the axis, and rotates indirectly the head, moving the face to its own side.

The *obliquus superior*, F, arises from the transverse process of the atlas, where the preceding is attached, and is inserted into the occipital bone between the curved lines, and near the mastoid process.

The muscle can draw back the head ; and may check a too great forward movement, as in nodding.

The *rectus posticus major*, G, arises from the spine of the second vertebra ; and widening as it ascends obliquely, it is inserted into the outer half of the lower curved line of the occipital bone, where it is partly concealed by the obliquus superior.

This muscle extends the head, and brings the face to its own side by rolling the atlas round the odontoid process of the axis.

Rectus posticus minor, H, arises from the arch of the atlas, close to the middle line; and is inserted into the inner half of the lower curved line of the occipital bone. The muscle extends the head.

ARTERIES OF THE BACK OF THE NECK.

Three arteries supply the back of the neck, and connect the vessels of the head with those of the trunk. In the neighbourhood of the thorax small offsets of the dorsal arteries appear.

a. Occipital artery.
b. Deep cervical branch of the occipital.
c. Offset to the small rectus muscle.
d. Vertebral artery.
e. Cervical branch of the vertebral.
f. Anastomosis of the vertebral and deep cervical arteries.
g. Deep cervical artery.
h. Dorsal arteries — the inner branches.

The *occipital artery*, *a*, courses to the integuments of the back of the head over the obliquus superior and the complexus, and beneath the sterno-mastoideus and the splenius: near the middle line it pierces the trapezius.

It furnishes a *cervical* branch, *b*, to the neck (ram. princeps cervicis), which descends beneath the complexus, B, supplying the deep muscles, and anastomoses with branches of the vertebral and deep cervical arteries. An offset passes over the complexus, and supplies the superficial muscles.

The *vertebral artery*, *d*, in its course to the interior of the skull is directed backwards in a groove on the neural arch of the atlas. Lying deeply in the bottom of the hollow between the large rectus and the oblique muscles, it furnishes one or two muscular offsets, *e*, and communicates with the contiguous arteries.

The *deep cervical artery*, *g*, is the dorsal offset of the upper intercostal (p. 170), and reaches the back of the neck by passing

between the transverse processes of the last cervical and first dorsal vertebræ. At the back of the neck it ascends under the complexus as high as the axis, where it communicates with the two arteries before described. It supplies chiefly the complexus and the semispinalis colli.

The height at which the artery appears is very uncertain; and it may be represented by two branches of different arteries. In obstruction of the circulation in the common carotid the blood will be conveyed to the exterior of the head by means of the anastomosis between the profunda and the occipital artery.

The *companion veins* of the arteries have not been included in the Plate: they resemble the arteries, with the exception of the vertebral which begins on the back of the head and neck, and does not enter the skull.

NERVES OF THE BACK OF THE NECK.

The anatomy of the posterior primary branches of the cervical nerves beneath the complexus is here shown. A part of the small occipital nerve appears behind the ear.

1. First or suboccipital nerve.
2. Second cervical nerve.
3. Third cervical nerve.
4. Fourth cervical nerve.
5. Fifth cervical nerve.
6. Sixth cervical nerve.
7. Seventh cervical nerve.
8. Small occipital nerve.

The *first nerve*, 1, appears beneath the vertebral artery, and ends in branches to the complexus, and the recti and obliqui muscles: it is joined to the second nerve by a loop.

Other cervical nerves. The remaining seven cervical nerves divide into two—inner and outer branches, as soon as they leave the spinal canal.

The *external branches* are not laid bare except that of the second: they are small, and are distributed to the muscles outside the complexus, viz., splenius, cervicalis ascendens, and transversalis colli and trachelo-mastoideus.

The *internal branches* are directed inwards—the four highest over, and the remaining three through the semispinalis colli;

and at the spines of the vertebræ those that lie on the semi-spinalis become cutaneous. They supply the complexus and the muscles filling the vertebral groove, with the interspinales. The following are the chief differences in these nerves :—

The branch of the second nerve, 2, the largest of all, pierces the complexus and trapezius, and becoming cutaneous is distributed to the occiput : it is named *great occipital*, and it is joined by the small occipital nerve, 8. It supplies branches to the inferior oblique and complexus muscles ; and it communicates by loops with the first and third nerves.

The cutaneous part of the third nerve, larger than those below it, sends upwards a branch to the occiput, which joins the large occipital nerve.

The connecting pieces between the inner branches of the first three nerves are sometimes absent. M. Cruveilhier describes this looped arrangement as the posterior cervical plexus.

The *small occipital nerve*, 8, is an offset of the cervical plexus (Plate xv.): it ends in the integuments of the occiput, and joins the great occipital nerve.

DESCRIPTION OF PLATE XX.

In this dissection of the pterygoid region the muscles of mastication, and the internal maxillary artery with its branches can be studied. Most of the branches of the inferior maxillary nerve come also into sight.

This superficial dissection will be made by detaching and throwing down the zygomatic arch with the masseter muscle ; by sawing off and raising the coronoid process with the temporal muscle ; and by removing the piece of the ramus of the jaw between the condyle and the dental foramen. After each sawing of the bone the fat is to be carefully removed.

MUSCLES OF MASTICATION.

The muscles employed in mastication are attached chiefly to the angle and processes at the back of the jaw ; but one, occupying the cheek, blends with the lip-muscles.

A. Temporal muscle.
B. External pterygoid muscle.
C. Internal pterygoid muscle.
D. Buccinator muscle.
F. Masseter muscle.
G. Digastric muscle (posterior belly).
H. Stylo-hyoideus.
L. Stylo-glossus.
N. Internal lateral ligament.
O. Styloid process.
P. Duct of the parotid gland.

The *temporal muscle*, A, arises from the temporal fossa on the side of the skull, and from the upper part of the temporal fascia ; and the fibres converge to a tendon which is attached to the coronoid process, and to the groove along the fore part of the ramus of the jaw.

Comparatively superficial above, the muscle passes below beneath the zygomatic arch and the masseter muscle, and rests on the external pterygoid, B. Near the zygoma a stratum of fat intervenes between the fleshy fibres and the temporal fascia.

In mastication this muscle crushes the food by raising the lower jaw ; and if the jaw has been moved forwards, the hinder fibres may be able to bring the bone backwards, with the aid of the muscles attached to the chin.

The *masseter muscle*, F, is placed external to the ramus of the jaw. It takes origin from the lower border and the inner surface of the zygomatic arch ; and it is inserted into the outer surface of the ramus of the jaw, from the tip of the coronoid process to the angle, and as far forwards as the second molar tooth. The superficial fibres take a direction down and back across the deeper and straighter fibres.

This muscle is the external elevator of the angle of the jaw.

The *internal pterygoid muscle*, C, has a position inside the ramus of the jaw similar to that of the masseter outside. The

muscle arises chiefly from the pterygoid fossa, but below from the palate and upper jaw bones by a process which extends in front of the lower part of the external pterygoid. It is inserted into the inner surface of the angle and ramus of the jaw as high as the dental foramen.

It raises the angle of the jaw in conjunction with the masseter, and may be considered the internal elevator of the angle.

The *external pterygoid* muscle, B, is directed almost horizontally back and out from the base of the skull to the condyle of the jaw. Arising from the outer surface of the external pterygoid plate, and from the contiguous part of the great wing of the sphenoid bone as high as the crest, the muscle is inserted into the neck of the lower jaw, and into the interarticular fibro-cartilage.

An interval separates the attachments to the external pterygoid plate and the great wing, through which the internal maxillary artery, *d*, usually passes.

If the muscles of both sides act the jaw is moved downwards and forwards, and the front lower teeth pass beyond the upper. If only one muscle acts, say the right, it draws the condyle of the same side further into the articular socket, and causes the chin to project to the left of the middle line, the grinding teeth of the lower jaw passing those of the upper from side to side.

The *buccinator* muscle, D, forms a thin fleshy layer in the cheek between the mucous membrane and the teguments. It is attached to the jaws opposite the molar teeth, and between the jaws at the back of the mouth to a fibrous band—the pterygo-maxillary ligament. Towards the corner of the mouth the fibres are aggregated together, and entering the lips blend with the muscles of the face.

In the movements of the lips the muscle retracts the corner of the mouth, and so widens that aperture, and wrinkles the cheek.

In mastication it is applied to the jaws, and prevents the food escaping out of the way of the teeth ; when it is paralysed the food distends the cheek in an inconvenient manner.

In playing a wind instrument the muscle is flattened, and the fibres are contracted for the purpose of keeping the outgoing air in the channel of the mouth ; but in the use of a blow-pipe the muscle is distended because the mouth is used as a reservoir, but the fibres contract at the same time, to maintain a continuous current of air.

INTERNAL MAXILLARY ARTERY.

The chief vessel in this dissection is the internal maxillary artery, which is continued through the pterygoid region to the deep parts of the head, the nose, and the palate, supplying many offsets.

a. External carotid artery.
b. Posterior auricular branch.
c. Superficial temporal artery.
d. Internal maxillary artery.
e. Inferior dental branch.
f. Branch with the gustatory nerve.
g. Deep temporal artery.
h. Buccal artery.
l. Posterior dental branch.
n. Facial artery.
r. Inferior labial branch.
s. Masseteric branch, cut.

The *internal maxillary* artery, *d*, is one of the terminal branches of the external carotid, and runs upwards and inwards over or under the external pterygoid muscle to the spheno-maxillary fossa, where it ends in branches to the nose, the palate, and the pharynx. It gives numerous branches, and these are classed into three sets : —one external to the pterygoid muscle, another whilst the trunk lies on the muscle, and a third internal to the muscle, or in the spheno-maxillary fossa. The first two sets will be mainly referred to now.

The *first set* of *branches*, two in number, belong to the skull and the lower jaw.

The *inferior dental* artery, *e*, enters the canal in the lower jaw with the nerve of the same name, and supplies the teeth and the lower part of the face. Before it enters the bone, a small offset (mylo-hyoid) descends with a fine nerve in a groove inside the ramus of the jaw.

The *large* or *middle meningeal* artery arises opposite the pre-

ceding, and is concealed by the external pterygoid: it is delineated in Plate xxi., *b*.

A third small artery, *f*, which has not been described by anatomists, runs with the gustatory nerve, and supplies the cheek and the floor of the mouth.

The *second set* of *branches* are distributed to the muscles of mastication as below :—

The *deep temporal*, *g*, two in number, enter the fore and hinder parts of their muscle. The *masseteric* branch, *s*, springs in common with the posterior temporal, and enters the hinder border of the masseter: it has been cut in the removal of the muscle. The *buccal* branch, *h*, descends to the cheek and the buccinator muscle: it anastomoses with the facial artery. Branches to the pterygoid muscles are shown in Plate xxi.

Third set of branches. Only one branch, the *posterior dental*, *h*, is seen in the dissection. It takes a tortuous course to the front of the upper jaw, where it communicates with the infra-orbital: it will be given more fully in Plate xxiii.

The *facial artery*, *n*, also a branch of the external carotid (Plate xvii.), is displayed as it crosses the jaw. It ascends in a tortuous way to the root of the nose, passing near the corner of the mouth.

Named branches supply the lips and the nose, and one of these to the lower part of the face is the *inferior labial*, *r*. Unnamed branches ramify in the cheek, and anastomose with the buccal and transverse facial arteries.

MAXILLARY AND FACIAL VEINS.

t. External jugular vein.
v. Superficial temporal.
w. Internal maxillary vein.
x. Facial vein.
z. Deep facial, or anterior internal maxillary.

The *facial vein*, *x*, begins where the companion artery ceases, and crosses the face to the jaw; but it takes almost a straight line from the root of the nose to the front of the masseter muscle, and does not follow the windings of the facial artery. It ends in the neck in the internal jugular trunk.

Besides branches received from the orbit and the face, it is joined opposite the angle of the mouth by a vein—the *deep facial*, *z*, or the anterior internal maxillary, which brings blood from the pterygoid region and the upper jaw.

Internal maxillary vein, *w*. Only the ending of this in the external jugular remains, the plexiform continuation of it by the side of the artery having been taken away.

NERVES OF THE PTERYGOID REGION.

The nerves appearing in this dissection are branches of the inferior maxillary trunk of the fifth cranial nerve, with the exception of one small nerve lying along the upper jaw, and another on the lower jaw.

1. Auriculo-temporal nerve.
2. Inferior dental nerve.
3. Gustatory nerve.
4. Masseteric nerve, cut.
5. Buccal nerve.
6. Posterior dental nerve.
8. Buccal branches of the facial nerve.

The anatomy of the inferior maxillary nerve is described with Plate xxi.; but the position of the several branches passing the external pterygoid can be here seen before the muscle is raised.

This large trunk of the fifth nerve is concealed as it leaves the skull by the external pterygoid; and its branches escape through the muscle or at the edges. Appearing at the upper border are the masseteric nerve, 4, and the deep temporal (Plate xxi., 8); and issuing at the lower border are three large trunks, viz., the auriculo-temporal, 1, the dental, 2, and the gustatory, 3. The *buccal nerve*, 5, comes forwards between the two pieces of the pterygoideus.

The *posterior dental nerve*, 6, a branch of the upper maxillary trunk, descends along the upper jaw with its artery: its origin and distribution may be referred to in Plate xxiii.

DESCRIPTION OF PLATE XXI.

THIS Illustration of the deep dissection of the pterygoid region exhibits the third trunk of the fifth cranial nerve, and the deep branches of the internal maxillary artery.

In preparing the dissection the internal maxillary artery should be cut through, and the condyle of the jaw having been disarticulated should be drawn forwards with the external pterygoid muscle. After the removal of the fat the nerves and vessels will be ready for learning.

MUSCLES OF MASTICATION.

The muscles described with Plate xx. are met with again in this view, and they are marked with the same letters of reference. A better idea of the wide origin of the external pterygoid is obtained in this Plate.

A. Temporal muscle.
B. External pterygoid muscle.
C. Internal pterygoid muscle.
D. Buccinator muscle.
F. Masseter muscle.
G. Digastric muscle.
H. Zygoma thrown down.
L. Condyle of the jaw.
N. Internal lateral ligament.
O. Styloid process, and stylo-maxillary ligament.

INTERNAL MAXILLARY ARTERY.

The meningeal and the muscular branches of the internal maxillary artery, which were hidden in Plate xx., will be now brought under notice ; and the other arteries, which are the same as in the preceding Figure, are marked by the same letters.

a. External carotid trunk.
b. Large meningeal artery.
c. Small meningeal branch.
d. Internal maxillary artery.
e. Inferior dental branch.
f. Branch with the gustatory nerve.
g. Deep temporal branches.
h. Buccal branch.
l. Posterior dental branch,
n. Facial artery.
t, External jugular vein.

The *large* or *middle meningeal* artery, *b*, ascends to the head beneath the external pterygoid muscle, and enters the skull through the foramen spinosum (p. 119). It supplies branches to the temporal and external pterygoid muscles, an offset to the tympanum through the Glaserian fissure, and the following :—

Small meningeal branch, c. Arising from the large meningeal, it enters the skull through the foramen ovale: an offset is furnished to the internal pterygoid with the branch of nerve to that muscle.

INFERIOR MAXILLARY NERVE.

The branches of the inferior maxillary nerve, whose lettering corresponds with that in Plate xx., are traced backwards to the foramen of exit from the skull.

1. Auriculo-temporal nerve.
2. Inferior dental nerve.
3. Gustatory nerve.
4. Masseteric branch, cut.
5. Buccal branch.
6. Chorda tympani nerve.
7. Mylo-hyoid branch.
8. Deep temporal branch.
9. Branch to the external pterygoid.

† Branch to the internal pterygoid.

The *inferior maxillary* or the third trunk of the fifth cranial nerve (Plate xiii.) leaves the skull by the foramen ovale, and splits at once into two under the external pterygoid muscle, viz.—an anterior small part, and a posterior larger part. And as the nerve is composed of a motor and a sensory root (p. 117), the function of these offsets will be determined by their receiving filaments from only one or from both roots.

The *small piece* of the nerve breaks up into branches to most of the muscles of mastication as below :—

The *masseteric branch*, 3, courses above the external pterygoid and through the sigmoid notch to the under surface of its muscle, in whose fibres it can be followed nearly to the anterior edge : it gives an offset to the back of the temporal muscle.

The *deep temporal* branch, 8, is directed upwards on the skull into the fibres of the temporal muscle, and usually with an artery of the same name.

The *buccal branch*, 5, pierces the external pterygoid, and is continued over the buccinator towards the corner of the mouth ;

it supplies chiefly the buccinator muscle as well as the integuments covering, and the mucous membrane lining the same. In the cheek it joins in a plexus, *buccal*, with the facial nerve (Plate xx., 8). Two masticatory muscles, viz., the external pterygoid and the temporal, receive offsets from the nerve.

A *branch* to the *external pterygoid*, 9, enters the under surface of that muscle.

This smaller part of the inferior maxillary nerve contains portions of both roots ; these are disposed in a peculiar way, and give different functions to the branches. Thus the nerves furnished by it to the jaw muscles—masseter, temporal, and external pterygoid—are constructed from both roots, like spinal nerves, and give sensibility and the power of contracting to those muscles. The nerve to the buccinator on the contrary is formed altogether by the sensory root, and bestows only sensibility on the muscle and the other parts to which it is distributed.

The *larger piece* of the *inferior maxillary* nerve ends in three good-sized trunks, and gives a branch to the internal pterygoid muscle.

The *auriculo-temporal* nerve, 1, beginning generally by two roots, is inclined backwards beneath the external pterygoid muscle, and ascends finally with the temporal artery to the integuments of the side of the head. It communicates largely with the facial nerve; and it supplies also the articulation of the jaw, the meatus of the ear, and the parotid gland.

The *inferior dental* nerve, 2, descends over the internal pterygoid and the internal lateral ligament to the dental foramen of the lower jaw, and is distributed to the teeth, and the lower part of the face.

A small muscular branch, *mylo-hyoid*, arises from the nerve near the jaw, and runs in a groove in the bone to the anterior belly of the digastricus, and the mylo-hyoideus (Plate xvii.).

The *gustatory nerve*, 3, is directed downwards to the front of the internal pterygoid, near the attachment to the jaw : its further course in the tongue will be represented in Plate xxii. Under the external pterygoid muscle it is joined by the chorda tympani nerve, 6.

The *branch* to the *internal pterygoid* muscle, †, comes from the large part of the inferior maxillary trunk, and enters the under surface of its muscle. Around the root of this branch, and on the inner or deep surface of the large trunk, lies the otic ganglion, which furnishes offsets to two other muscles, viz., the tensor tympani and the circumflexus palati: this body can be recognised only in a view from the inner side.

The large part of the inferior maxillary trunk receives fibrils from both roots of the fifth nerve, like the smaller piece; but as the part contributed by the sensory root is much the largest, most of the branches are formed by this alone, and are therefore sensory in function. The three large trunks, auriculo-temporal, 1, dental, 2, and gustatory, 3, are solely sensory nerves—and the last is one of the nerves of taste. The muscular branches receiving offsets from both roots, bestow sensibility and contractility on the muscles before mentioned, viz., the pterygoideus internus, the mylo-hyoideus, the anterior belly of the digastricus, the circumflexus palati, and the tensor tympani.

The *chorda tympani nerve*, 6, is a branch of a motor nerve—the facial (p. 117), and issues from the cranium through, or by the side of the Glaserian fissure. It is applied to the gustatory under the external pterygoid muscle, and is conveyed by that nerve trunk to the tongue, where it is distributed: at the point of contact one or two offsets join the gustatory.

The two following pieces of fascia, which are called ligaments, look like distinct bands in consequence of the removal of the rest of the cervical fascia, with which they are continuous.

The *internal lateral ligament* of the articulation of the jaw, N, is attached by one end to the base of the skull, and by the other to the margin of the dental foramen and the bone above the insertion of the internal pterygoid muscle: it is part of the deep fascia projecting under the jaw.

The *stylo-maxillary ligament*, O, reaches from the styloid process to the hinder and lower parts of the ramus of the jaw: this piece of the fascia is continuous below with that separating the parotid and submaxillary glands (Plate xvi., N.).

DESCRIPTION OF PLATE XXII.

THE dissection of the submaxillary region is indicated in this Figure.

The steps of the dissection are the following:—The soft parts over the jaw are to be divided, and the bone is to be sawn through rather on the right of the symphysis; then, the tongue having been drawn out of the mouth, the mucous membrane is to be cut along the centre below, to trace forwards the vessels and nerves.

To make tense the muscles, fasten down the os hyoides with a stitch to one of the firm surrounding parts.

MUSCLES OF THE TONGUE AND THE HYOID BONE.

Extrinsic muscles of the tongue and elevators of the os hyoides occupy the interval between that bone and the tongue.

A. Mylo-hyoideus, reflected.
B. Genio-hyoideus.
C. Genio-glossus.
D. Hyo-glossus.
E. Stylo-glossus.
F. Stylo-hyoideus.
G. Middle constrictor.
H. Digastricus.
J. Inferior constrictor.
K. Thyro-hyoideus.
L. Omo-hyoideus.
N. Sterno-hyoideus.
O. Stylo-hyoid ligament.
P. Great cornu of the hyoid bone.
Q. Thyroid cartilage.

Elevators of the os hyoides. Some of the muscles of this group, viz., the mylo-hyoideus, A, the stylo-hyoideus, F, and the digastricus, H, have been described (p. 157): the remaining elevator is given below.

Genio-hyoideus, B. It arises from an eminence inside the symphysis of the jaw, and is inserted below into the centre of the body of the hyoid bone. The muscle touches its fellow along the middle line, and lies between the genio-glossus, C, and the mylo-hyoideus, A.

When the mouth is shut the muscle will raise the hyoid bone;

or the os hyoides being fixed, it will help to bring down the jaw, as in the act of opening the mouth.

Extrinsic tongue muscles. There are four on each side, viz., hyo-glossus, genio-glossus, stylo-glossus, and chondro-glossus: only the three first are now laid bare.

Hyo-glossus, D. This thin muscle arises from the hyoid bone, viz., from the great cornu by one part (cerato-glossus), and from the body of the hyoid bone by another* (basio-glossus). From this attachment the fibres ascend and enter the side of the tongue.

With the os hyoides fixed the hyo-glossus can depress the tongue in the floor of the mouth and give to that organ a rounded form. Supposing the tongue the fixed point the muscle will raise the hyoid bone, preparatory to swallowing.

The *stylo-glossus*, E, arises from the styloid process and the stylo-maxillary ligament (Plate xx.), and enters the back of the tongue; but its fibres extend forwards beneath the side of the tongue to the tip where they blend with their fellows.

The muscles of opposite sides contracting will draw back and up the base of the tongue; and by the action of one muscle the point of the tongue will be turned to the same side of the mouth.

Genio-hyo-glossus, C. Shaped like a fan, it arises by a narrowed part from a tubercle inside the symphysis of the jaw; and it is inserted along the middle of the tongue from tip to root, as well as into the body of the hyoid bone. In contact with its fellow by the inner surface, the anterior edge is covered by the mucous membrane of the mouth, and the posterior touches the genio-hyoideus, B.

All the fibres contracting the tongue will be sunk in the floor of the mouth, and notably its middle part, so as to give a concavity to the upper surface. If only the lower fibres act they will raise the hyoid bone and put forwards the tongue between the teeth: by means of the last mentioned fibres the muscle will be able to dilate anteriorly the pharynx.

The *stylo-hyoid ligament*, O, stretches between the end of the styloid process and the small cornu of the hyoid bone. Below, it

* Another fleshy slip (chondro-glossus), which is attached to the small cornu of the bone, is considered to form a third part of the muscle.

lies beneath the hyo-glossus, and gives attachment to the middle constrictor, G. Sometimes this band is large and cartilaginous or even osseous; at other times it is slight, and so membranous as not to be recognised.

The *Pharynx.* In front of the carotid blood vessels is the upper dilated part of the gullet, or the pharynx. Its wall contains thin muscles which overlap one another, and the chief of these are called constrictors: two are marked with G and J, but they will be more fully noticed in Plate xxv.

SALIVARY GLANDS.

The sublingual gland, and parts of the submaxillary and parotid. are exposed in the dissection.

R. Sublingual gland.
S. Piece of the submaxillary.
T. Part of the parotid.
† Wharton's duct.

Submaxillary gland, S. A deep part of the gland projects beneath the mylo-hyoid muscle, and with it the excretory duct is connected.

Wharton's duct, †, is about two inches long; it ascends beneath the gustatory nerve and the sublingual gland to the floor of the mouth, and ends in an eminence on the side of the frænum linguæ.

The *sublingual gland,* R, lies beneath the fore part of the tongue, where it forms a prominence, but it is separated from the cavity of the mouth by the mucous membrane. Elongated from before back, it is about one inch and a half in length, and meets its fellow in front.

Its ducts are numerous (8 to 20), and open for the most part by separate orifices in the floor of the mouth, but some join the duct of the submaxillary gland.

LINGUAL VESSELS.

The vessels of the tongue are few in number, in comparison with the nerves, there being but one on each side.

a. Common carotid trunk.
b. External carotid artery.
c. Upper thyroid branch.
d. Lingual artery.
e. Ranine branch.
f. Sublingual branch.
g. Facial artery, cut.
h. Occipital artery.
i. Branch of the sublingual artery.
l. Internal jugular vein.

The *lingual artery*, *d*, springing from the external carotid, runs obliquely upwards beneath the hyo-glossus to the under surface of the tongue, where it takes the name *ranine*, and continues along the middle line to the tip—distributing offsets. Near the front of the tongue the arteries of opposite sides correspond with the frænum linguæ in position, and may be cut when that fold of the mucous membrane is snipped with a scissors in tongue-tied infants.

A few named branches come from the artery: the most unimportant is the *hyoid* branch, which supplies one or more of the muscles attached to the os hyoides.

Beneath the hyo-glossus a *dorsal lingual* branch takes its origin; and at the fore part of that muscle arises the *sublingual* branch, *f*, which supplies the gland of the same name and the contiguous muscles, and joins the artery of the opposite side by means of the twig, *i*.

Lingual vein.—Its anatomy is similar to that of the artery, and it ends in the internal jugular vein.

NERVES OF THE TONGUE.

Six large nerves end in the tongue; and the three of the right side are delineated as they course through the submaxillary region.

1. Glosso-pharyngeal nerve.
2. Hypoglossal nerve.
3. Descendens noni branch.
4. Upper laryngeal nerve.
5. Gustatory nerve.
6. Submaxillary ganglion.
7. Loop between the gustatory and hypoglossal nerves.

The *hypoglossal nerve*, 2 (twelfth cranial, Plate xxiv.), is the motor nerve of the tongue. Coursing with the lingual artery as far as the hyo-glossus it passes over this muscle, and enters the fibres of the genio-hyo-glossus, in which it is continued to the

tip of the tongue, gradually decreasing in size by the supply of offsets.

On the hyo-glossus it furnishes branches to three extrinsic tongue muscles—the hyo, stylo, and genio-glossus; and to one elevator of the hyoid bone—genio-hyoideus. It joins the gustatory nerve, 5, by means of the loop, 7.

The *glosso-pharyngeal* nerve, 1 (ninth cranial), taking the course of the stylo-pharyngeus muscle (Plate xxiv.), enters beneath the hyo-glossus to reach the mucous membrane and the papillæ of the hinder and lateral parts of the tongue. Beneath the hyo-glossus muscle it furnishes offsets to the pharynx, the arches of the soft palate, and the tonsil.

The nerve confers sensibility on the mucous membrane of the pharynx, and gives the power of tasting in the back of the tongue and the pillars of the soft palate.

The *gustatory nerve*, 5, coming from the pterygoid region (Plate xxi.), appears between the jaw and the internal pterygoid muscle, and courses forwards along the under surface of the tongue to the tip. At first the nerve rests against the prominence inside the last molar tooth; and in the rest of its extent in the tongue it lies near the edge, covered by the mucous membrane.

Offsets from it supply the mucous membrane of the floor of the mouth, the submaxillary and sublingual glands, and the tongue in front of the glosso-pharyngeal nerve—especially the mucous membrane and the papillæ.

As this branch of the fifth cranial nerve does not receive any filaments of the motor root (p. 185) its function is sensory; and the power of tasting in the fore part of the tongue is dependent upon it.

Submaxillary ganglion, 7. This little body resembles the lenticular ganglion in the orbit (Plate xiv.), and is connected with the branch of the fifth nerve distributed to the tongue. Smaller than the lenticular ganglion, and occasionally reddish in colour, it lies just above the submaxillary gland.

Some branches are furnished to the submaxillary gland and the mucous membrane of the mouth.

Other branches, called roots sometimes, join with the surrounding nerves, like the communicating branches of the lenticular ganglion. Thus it is connected above with the gustatory—a sensory nerve ; with the facial—a motor nerve, by means of the chorda tympani (p. 185), which runs by the side of the gustatory to the tongue, and gives a slender thread to the back of the ganglion ; and with the sympathetic through the plexus of that nerve on the facial artery.

DESCRIPTION OF PLATE XXIII.

In this dissection the second trunk of the fifth nerve, and a part of the internal maxillary artery are brought into view.

Supposing the head and the orbit opened, the dissection will be completed by removing the outer wall of the orbit, and the side of the cranium forming part of the middle fossa of the base of the skull.

SOME MUSCLES OF THE FACE.

Some of the muscles of the eyelids and upper lip being partly displayed will be referred to shortly ; the other muscles, viz., those of mastication, have received sufficient notice already.

A. External pterygoid muscle.
B. Masseter muscle.
C. Buccinator muscle.
D. Levator anguli oris.
E. Levator labii superioris.
F. Levator lab. sup. alæque nasi.
G. Orbicularis palpebrarum.
H. Rectus oculi superior.
I. Antrum maxillare.
L. Obliquus oculi inferior.

Orbicularis palpebrarum, G. This thin sphincter muscle occupies the eyelids, forming loops around their aperture, and extends beyond the margin of the orbital cavity.

When the fibres contract the lids are closed, the upper one

being specially brought down; and the integuments around the eye are wrinkled, and drawn towards the nose. In paralysis of the muscle the eyelids cannot be brought together, and the eyeball remains constantly uncovered.

Elevators of the upper lip. Three muscles raise the upper lip, viz., a common and a special elevator, and an elevator of the angle of the mouth.

The *elevator of the angle*, D, arises from the canine fossa of the upper jaw bone, and blends at the corner of the mouth with other muscles.

The *special elevator*, E, arises from the margin of the orbit over the infra-orbital foramen, and joins the sphincter of the mouth.

The *common elevator*, F, arises from the upper jaw bone at the inner side of the orbit, and ends at the mouth like the preceding: it is attached also to the wing of the nose by a separate slip.

These muscles contracting together will raise the upper lip; but the elevator of the angle can act independently of the others, and raise the corner of the mouth. Commonly, elevation of the lip and of the wing of the nose follows forced contraction of the sphincter of the eyelids, in consequence of a fleshy slip being prolonged from the orbicularis to the special elevator.

INTERNAL MAXILLARY ARTERY.

Two of the terminal branches of the internal maxillary artery at the spheno-maxillary fossa are traced out in the dissection.

a. Internal maxillary artery.
b. Posterior dental branch.
c. Infra-orbital branch.
d. Buccal branch.
e. Internal carotid artery in the skull.
f. Ophthalmic artery.
g. External carotid trunk.
h. Superficial temporal branch.
n. Transverse facial branch.

The *posterior dental* artery, *b*, springing from the internal maxillary near the spheno-maxillary fossa, is inclined downwards

and forwards over the upper maxilla to the front of the bone, and anastomoses with the infra-orbital artery.

It supplies superficial and deep branches :—the former descend to the buccinator muscle, the periosteum, and the gums ; and the latter enter foramina in the bone, and supply offsets to the fangs of the teeth and to the lining membrane of the antrum maxillare.

The *infra-orbital* artery, *c*, arises near the preceding, and enters the infra-orbital canal with the upper maxillary nerve. Continued through that canal, it issues at the infra-orbital foramen, and ends in branches for the lower eyelid and the parts between the orbit and mouth : it communicates with the facial, transverse facial, and posterior dental arteries.

Many small offsets are furnished to the orbit ; and near the front of the jaw bone it sends downwards an *anterior dental* branch, with a nerve, 8, of the same name, to supply the incisor and canine teeth.

The *transverse facial* artery, *n*, commonly a branch of the superficial temporal, crosses the side of the face, supplying the contiguous parts, and anastomoses with the facial and the infra-orbital arteries.

UPPER MAXILLARY NERVE.

The second trunk of the fifth cranial nerve (p. 117) is named as above from passing through the upper maxilla ; it supplies the teeth of the upper jaw.

1. Posterior dental branch.
2. Upper maxillary nerve.
3. Optic nerve.
4. Orbital branch, cut.
5. Ophthalmic trunk.
6. Inferior maxillary trunk.
7. Buccal branch.
8. Anterior dental branch.
9. Branches of the facial nerve.

The *upper maxillary* nerve, 2, leaves the skull by the foramen rotundum, and courses to the face across the spheno-maxillary fossa, and through the infra-orbital canal. In the face it splits into large branches which are distributed to the muscles and the integuments between the eye and the mouth : a fine offset

ascends with a small artery to the lower eyelid and the orbicular muscle. Its facial or terminal branches join in a plexiform manner with branches of the facial nerve. It gives off the following branches :—

Dental branches :—These are usually two in number, one at the back, and the other at the front of the maxilla.

The posterior branch, 1, descends on the jaw, gradually diminishing in size, and is received into a canal in the bone. Most of its branches course through the bone to supply the grinding teeth, but one or two slender offsets are furnished to the gums and the buccinator muscle.

The anterior branch, 8, is conducted by a bony canal in front of the antrum to the bicuspid and incisor teeth : it sends some filaments to the mucous lining of the nose, and joins the posterior branch.

Orbital and *spheno-palatine* branches :—Opposite the spheno-maxillary fossa the remaining branches arise.

The orbital branch, 4 (temporo-malar), is a cutaneous nerve of the face and temple, and receives its designation from passing through the cavity of the orbit. In the dissection it was cut necessarily by the removal of the outer wall of the orbit. In its uninjured state the nerve can be traced into the orbit, where it splits into a temporal and a malar branch ; these issue to their destination through apertures in the malar bone.

The spheno-palatine branches, two in number, descend beneath the internal maxillary artery, and communicating with Meckel's ganglion in the spheno-maxillary fossa, supply the lining membrane of the nose and the roof of the mouth ; the soft palate, and the tonsil; and the pharyngeal mucous lining near the Eustachian tube.

The upper maxillary trunk of the fifth nerve springs from the Gasserian ganglion without commixture with the motor root, and is solely a sensory nerve, like the first or ophthalmic trunk. To its influence is due the sensibility of a part of the face, of the teeth of the upper jaw, of the nose cavity, and of the roof of the mouth and the soft palate.

Facial nerve.—The branch, of rather large size, which is

marked with 9, is called infra-orbital: it lies below the orbit, and supplies the muscles between the eye and mouth, and on the nose. In its course inwards its offsets cross, and join the branches of the upper maxillary nerve, forming the infra-orbital plexus by this arrangement.

The facial is the motor nerve chiefly of the muscles of the face and head; and it is distributed for the most part to muscles receiving sensibility from the three trunks of the fifth cranial nerve. To the buccinator, which acts as a muscle of mastication as well as a dilator of the aperture of the mouth, it gives motor power; and consequently this muscle is paralysed when the other muscles which are supplied by the facial nerve lose their power of contracting.

DESCRIPTION OF PLATE XXIV.

This Illustration will serve as a guide to the dissection of the internal carotid and ascending pharyngeal arteries, and of the cranial nerves distributed in the neck.

After the examination of the pterygoid region and the upper maxillary nerve, the dissection delineated will be prepared by detaching the styloid process with its muscles, and the external carotid artery and its branches; and by sawing off the large piece of the side of the skull outside the jugular foramen and the carotid canal. Finally a dense fibrous tissue surrounding the nerves and vessels near the base of the skull should be taken away carefully; and as the internal jugular vein renders obscure the view of many objects it may be removed.

DEEP MUSCLES OF THE NECK.

Lying on the front of the spinal column are the deep muscles for the flexion and rotation of this part of the spine, and of the

head, which will be now described. And superficial to the level of the carotid bloodvessels is the group of muscles before referred to in part, which belongs to the pharynx and tongue, and the hyoid bone and the larynx.

A. Scalenus anticus.
B. Scalenus medius.
C. Sterno-mastoideus.
D. Splenius capitis, cut.
E. Levator anguli scapulæ.
F. Obliquus oculi inferior.
G. Obliquus oculi superior.
H. Rectus capitis lateralis.
I. Pterygo-maxillary ligament.
J. Rectus capitis anticus major.
K. Longus colli.
L. Sterno-hyoideus.
M. Sterno-thyroideus.
N. Thyroid body.
O. Omo-hyoideus.
P. Thyro-hyoideus.
Q. Hyo-glossus.
R. Constrictor inferior.
S. Constrictor medius.
T. Submaxillary gland.
U. Styloid process, cut off.
V. Stylo-glossus.
W. Stylo-pharyngeus.
X. Constrictor superior.
X'. Buccinator.
Y. Levator palati.
Z. Tensor palati.
‡ Cartilage of the Eustachian tube.

The *rectus capitis lateralis*, H, resembles in position an inter-transverse muscle; it is attached below to the lateral part of the atlas, and above to the jugular eminence of the occipital bone.

The muscle will approximate the skull to the atlas, and so help in inclining the head towards the shoulder.

The *rectus capitis anticus major*, J, is continued upwards in a line with the anterior scalenus. Arising below where the scalenus is attached, viz., from the transverse processes of the 6th, 5th, 4th, and 3rd cervical vertebræ, it ascends, becoming thicker near the skull, to be inserted into the basilar process of the occipital bone.

If the muscles of opposite sides act the head will be bowed forwards; but only one acting it will turn the face to its own side, in consequence of its oblique position.

A third rectus muscle (rect. cap. anticus minor) lies between the two preceding, and passes from the atlas to the basilar process of the occipital bone; it is concealed by the vessels and nerves near the head.

LL

The *longus colli* muscle, K, lies on the front of the spinal column between the atlas and the second dorsal vertebra, and it is attached to the bodies of the vertebræ and to certain of the transverse processes. For the complete display of the muscle the pharynx should be detached.

The muscle bends forwards the spine, and can rotate the same by means of the lateral slips connected with the transverse processes.

SUBCLAVIAN AND CAROTID ARTERIES.

In this Illustration the internal carotid artery can be observed throughout; and by means of the Figure a more complete view of some of the branches of the subclavian and carotid trunks may be obtained.

a. Subclavian trunk.
b. Vertebral artery.
c. Internal mammary branch.
d. Thyroid axis.
e. Inferior thyroid artery.
f. Supra-scapular artery.
g. Transverse cervical artery.
h. Ascending cervical branch.
i. Common carotid trunk.
k. Upper thyroid artery.
l. Crico-thyroid branch.
m. External carotid trunk.
n. Laryngeal branch.
o. Lingual artery.
p. Facial artery.
q. Occipital artery, cut; with a branch to sterno-mastoideus.
r. Tonsillitic branch.
s. Inferior palatine branch.
t. Ascending pharyngeal artery.
u. Internal carotid trunk.
x. Internal mammary artery, cut.
y. Internal jugular vein, cut.

Subclavian trunk.—The arch of the subclavian artery, and the branches of its first part (p. 157) are here represented.

In this body a rare condition of the *inferior thyroid artery, e,* existed;* the vessel sprang from the vertebral artery, *b,* instead of the thyroid axis, *d,* and then took its usual course to the thyroid body, N.

Common carotid artery, i.—The extent and situation of the artery, and the nerves in connection with it (p. 158) can be well perceived in this Plate. In this body the arterial trunk split into two at a point higher than usual.

* Mr. Quain's Surgical Anatomy of the Arteries, p. 169, where it is said to have been seen once.

External carotid trunk, m.—Only the lower part of the artery, with the first branches, which were not represented or only imperfectly in preceding Plates, has been left in the dissection. And as the carotid begins above the usual place these first branches have to descend to their destined positions.

The *upper thyroid, k*, runs over the superficial surface of the thyroid body, N, before entering the substance. It furnishes, firstly, muscular offsets ; next a laryngeal branch, *n ;* and lastly, a crico-thyroid branch, *l*, which lies on the membrane of the same name, joining that of the opposite side, and would be endangered in the operation of laryngotomy.

Lingual artery, o :—its hyoidean offset arises before the artery passes beneath the hyo-glossus, Q, and is distributed to the thyro-hyoideus, P.

The *facial artery, p*, furnishes the following branches to the neck before it reaches the jaw :—

A tonsillitic offset, *r*, ascends between the pterygoideus internus and the stylo-glossus, V, and perforating the upper constrictor, X, ends in the tonsil and the side of the tongue.

An inferior palatine branch, *s*, courses along the side of the pharynx between the stylo-glossus and stylo-pharyngeus muscles to the upper border of the superior constrictor, X, where it passes inwards to supply the palate. It supplies muscular branches, and one, long and slender, reaches the Eustachian tube, ‡.

Other offsets of the facial, viz., submental and glandular are given in Plate xvii.

The *ascending pharyngeal artery, t*, arises near the beginning of the external carotid, and ascends on the spinal column between the pharynx and the internal carotid trunk nearly to the skull. Here it enters the pharynx above the upper constrictor, and ends in branches to the front and back of the soft palate ; of these the anterior are the largest, and join with corresponding branches of the opposite side, so as to form two arches beneath the mucous membrane—one lying near the upper, and the other near the lower edge of the velum palati—(Quain).*

* Fifth edition of Quain's Anatomy, 1846, p. 489.

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Branches are given to the contiguous muscles, the lymphatic glands, and nerves; and one (meningeal) enters the skull through the foramen lacerum, and ends in the dura mater.

The *internal carotid* artery, *u*, ascends through the neck and the temporal bone to the interior of the cranium, and terminates in branches for the brain and the orbit.

The cervical part of the vessel, of the same size throughout and devoid of branches, lies by the side of the pharynx, and rests on the rectus anticus, J. At first the artery is accessible in an operation (p. 160) but it becomes deep afterwards beneath the parotid gland and the digastricus and the styloid process and its muscles.

The internal jugular vein is contained in a sheath of fascia with the artery, and is external or posterior to it.

Numerous nerves are in contact with the vessel. Crossing it superficially from above down are the glosso-pharyngeal, 1, the pharyngeal branch of the vagus, 5, and the hypoglossal nerve, 7; and beneath it, also with a cross direction, are pharyngeal branches of the sympathetic, the upper laryngeal, 3, and the external laryngeal, 4. In the sheath between it and the vein, and parallel to it, lies the vagus nerve, 2; and behind the sheath and parallel, is placed the sympathetic nerve with its branches. Close to the skull the cranial nerves issuing by the foramen jugulare and anterior condyloid foramen interpose between the artery and vein, but they diverge afterwards to their destination.

In the temporal bone the artery becomes flexuous, and fills the carotid canal, only a few branches of the sympathetic intwining around it: here it gives a small tympanic branch to the ear, which pierces the bone.

For the anatomy of the artery in the skull see Plate xiii. (p. 119); and for the description of the ophthalmic artery refer to p. 122.

DEEP NERVES OF THE NECK.

The sympathetic and four cranial nerves with their branches, together with the spinal nerves of the neck, are visible in the Plate.

1. Glosso-pharyngeal nerve.
2. Vagus nerve.
3. Upper laryngeal nerve.
4. External laryngeal branch.
5. Pharyngeal branch.
6. Spinal accessory nerve.
7. Hypoglossal nerve.
8. Descendens noni branch.
9. Communicating branch from the spinal nerves.
10. Recurrent laryngeal nerve.
11. Cord of the sympathetic nerve.
12. Upper cervical ganglion.
13. Middle cervical ganglion.
14. Lower cervical ganglion.
15. Middle cardiac nerve.
16. First cervical nerve (loop of the atlas).
17. Second cervical nerve.
18. Third cervical nerve.
19. Fourth cervical nerve.
20. Phrenic nerve.
21. Fifth cervical nerve.
22. Sixth cervical nerve.
23. Seventh cervical nerve.
24. Eighth cervical nerve.
25. Supra-scapular nerve.
26. Carotid branches of the sympathetic.
27. Upper maxillary nerve.
28. Optic nerve.

†† Cardiac branches of the vagus in the neck.

The *glosso-pharyngeal* or ninth cranial nerve, 1, leaves the skull by the jugular foramen, and courses to the pharynx over the carotid artery; passing then beneath the hyo-glossus muscle, Q, it ends in terminal branches for the tongue. In the foramen of exit the nerve possesses two small ganglia, and furnishes a branch (Jacobson's nerve) to the tympanum. Its branches beyond the cranium are the following:—

As it crosses the carotid artery some fine filaments descend on the vessel, and join the sympathetic and the pharyngeal branch, 5, of the vagus.

Muscular branches enter the stylo-pharyngeus and the upper two constrictors; and at the side of the pharynx it joins in a plexus (pharyngeal) with offsets of the sympathetic and the pharyngeal branch of the vagus.

Numerous offsets are distributed to the mucous membrane of the pharynx opposite the opening of the mouth.

The nerve is chiefly sensory in its function, and it confers on a part of the tongue the power of tasting as before said (p. 190); but as the stylo-pharyngeus muscle is supplied altogether by it some motor power must be obtained from it. By means of its branches to the lining of the pharynx impressions produced by the presence of food are conveyed to the sensorium.

The *pneumo-gastric*, vagus, or tenth cranial nerve, 2, issues from

the skull by the foramen jugulare. In the aperture of exit it has a ganglion (gang. of the root); and it gives a branch to the ear, like the glosso-pharyngeal.

Beyond the skull it is continued through the neck to the thorax, lying in the carotid sheath between the artery and the jugular vein; and as it leaves the neck on the right side it crosses the subclavian artery. Near the skull is a long fusiform ganglion (gang. of the trunk), which is united with the hypoglossal nerve 7. In the neck the nerve supplies the undermentioned branches to the pharynx, the larynx, and the heart.

The *pharyngeal* branch, 5, begins in the ganglion, and crosses over (sometimes under) the internal carotid, to reach the pharynx. After being joined by offsets of the glosso-pharyngeal, it communicates with the sympathetic and the superior laryngeal to form the pharyngeal plexus: it ends in the constrictor muscles.

The *upper laryngeal* nerve, 3, arises also from the ganglion, and courses under the carotid to the interval between the hyoid bone and the thyroid cartilage: here it pierces with an artery the thyro-hyoid ligament, and is distributed to the mucous membrane of the larynx. See Plate of the larynx.

Under the carotid it joins largely with the sympathetic nerve; and it furnishes the *external laryngeal* nerve, 4, which supplies the inferior constrictor, and ends in the crico-thyroideus muscle (Plate xxv).

Cardiac branches, † †. One springs from the nerve trunk at the lower, and one or two at the upper part of the neck: they join branches of the sympathetic. In this dissection the upper communicated with the descendens noni nerve.

Recurrent or *inferior laryngeal* nerve, 10. On the right side this nerve arises as the vagus enters the thorax, and winding round the subclavian artery, runs back to the larynx: it is distributed chiefly to the laryngeal muscles. See Plate xxvii. On the left side the nerve begins in the thorax opposite the arch of the aorta, round which it makes a loop to come back to the larynx.

In the neck the pneumo-gastric nerve ramifies in the walls of

the air and food passages, and bestows sensibility on the mucous membrane and contractility on the muscular structure; but the contraction of the muscles supplied not being placed under the control of the will (except those of voice), the nerve resembles more the sympathetic than the other motor cranial nerves.

From the partial mixing of its motor and sensory nerve fibres the branches in the neck have different functions. Experiments seem to determine that the pharyngeal branch is a motor nerve; the superior laryngeal, sensory; and the recurrent laryngeal a motor nerve of the muscles of the larynx, but an involuntary motory, and sensory to the muscular fibres in the trachea. The small cardiac branches are probably involuntary motory, and sensory in function.

The *spinal accessory* or eleventh cranial nerve, 6, comes out of the skull by the foramen jugulare, and communicates in that aperture with the vagus by means of an accessory piece.

Beyond the foramen the nerve is directed downwards and backwards to the sterno-mastoideus, which it pierces, and to the Trapezius muscle (Plate xv. p. 146). It joins freely with branches of the cervical plexus, and supplies in part the two muscles named.

This nerve resembles a spinal nerve in arising from the spinal cord, and in being moto-sensory in function; and this double power is not altogether dependent upon its junction with the spinal nerves, for it may supply alone the sterno-mastoideus.

The *hypoglossal*, or twelfth cranial nerve, 7, leaves the skull by the anterior condyloid foramen, and turning over the vagus, with which it is inseparably united, descends as low as the digastric muscle before it is directed forwards to the tongue. No offset is distributed from the first part of the nerve, though it joins the vagus, the sympathetic, and the first spinal nerve; but many muscular branches arise from the last part of the hypoglossal, as may be seen in Plate xxiii.

It is supposed to be altogether a motor nerve at its origin, and that any sensory power it possesses is derived from its junction with the other nerves near the skull.

Sympathetic nerve.—The cervical part of the sympathetic nerve, 11, lies on the spine beneath the great bloodvessels, and is continuous with the knotted cord in the thorax. In the neck it is marked by three ganglia—upper, middle and lower ; and each ganglion furnishes external or communicating branches, internal or visceral, and branches to blood-vessels.

The *upper ganglion*, 12, is the largest of the three : it is fusiform in shape, with a reddish colour, and is about two inches long. Near the base of the skull the cranial nerves lie over it.

Most of the inner branches pass beneath the carotid to join in the pharyngeal plexus ; but one, larger than the rest and named *upper cardiac*, descends beneath the artery to the cardiac plexus in the thorax.

The outer branches communicate with the first four spinal nerves, and with the tenth and twelfth cranial nerves.

The nerves to blood-vessels from the *ganglion* (nervi molles) ramify on both carotid arteries, forming plexuses on them ; and on some of the branches of the external carotid there are interspersed ganglia. Through the offset, 26, on the internal carotid the vessels and the vascular membrane of the brain are supplied, and communications take place with the cranial nerves in the middle fossa of the base of the skull.

The *middle ganglion*, 13, variable in size and shape, is placed near the inferior thyroid artery, *e*, and is smaller than the others. Its offsets are the following :—

Outer branches which join usually the fifth and sixth spinal nerves.

Inner branches ramify on the thyroid artery and end in the thyroid body. One of these, the *middle cardiac* nerve, 15, is continued to the cardiac plexus in the thorax.

The *inferior ganglion* lies beneath the subclavian artery and close above the neck of the first rib. It is rather rounded in shape, and is often divided into parts, as in the Figure, where one of the pieces is marked, 14. Its branches are similar to those of the other ganglia.

Outer branches, two or more in number, join the two lowest cervical nerves.

One large inner or visceral branch, *inferior cardiac*, runs beneath the subclavian to the cardiac plexus in the thorax.

Offsets to the bloodvessels intwine around the vertebral artery, *b*, forming a plexus on it; and other nerves ramify on the subclavian trunk which they surround with one or two loops.

The branches of the sympathetic in the neck serve chiefly to connect this nerve with others, and to supply the bloodvessels.

By means of the communicating branches with the cranial and spinal nerves the sympathetic gives fibres to and receives fibres from those nerves; and the offsets joining the anterior primary trunk of each spinal nerve are directed through the roots of the nerve towards the spinal cord, and send also some fibres to the trunk of the nerve to be distributed peripherally with it.

To the bloodvessels the sympathetic gives the power of regulating the quantity of blood circulating through them; so that on section of the vaso-motory nerves the muscular coat is paralysed, and being unable to contract on the contained fluid, the blood slackens in speed, and congestion of the vessels of the part and increased heat ensue. Stimulating the cut nerves by galvanism will restore for the time contraction of the muscular coat, and will cause a decrease in the congestion and the heat.

Spinal nerves.—Eight in number, they are divided equally between two plexuses;—the upper four entering the cervical, and the lower four the brachial plexus.

Cervical plexus.—The anterior primary branches of the first four nerves interlace in the cervical plexus: they are marked 16 to 19 inclusive, and the small branch of the first, 16, is named the loop of the atlas. The superficial offsets of the plexus are delineated in Plate xv.; the deep branches follow below:—

Branches to muscles.—From the loop between the first two nerves branches are furnished to the contiguous recti muscles; and from the other loops of the plexus the surrounding muscles, viz., the sterno-mastoideus C, Levator anguli scapulæ E, scalenus medius B, intertransversales, trapezius, and the platysma, receive nerves.

Communicating branches.—Offsets unite the loop of the atlas with the vagus and hypoglossal nerves, 2 and 7, and with the upper ganglion of the sympathetic, 12. And two small branches from the second and third nerves, 17 and 18 (in this case one comes also from the fourth nerve, 19) join in one, 9, which unites with the descendens noni, and assists to supply the depressor muscles of the hyoid bone.

The *diaphragmatic* or *phrenic* nerve, 20, begins in the fourth cervical nerve, but it often joins the trunk of the fifth nerve, 21, as it passes by. It descends to the thorax over the scalenus anticus A, and inside the internal mammary artery, *c*, as in the Drawing.

Brachial plexus.—The lower four nerves are much larger than the upper, and are prolonged to the upper limb. The trunks, marked from 21 to 24 inclusive, issue between the anterior and the middle scalenus,* and join with part of the first dorsal in the large cords seen in the Figure.

Only two of the branches arising from the plexus above the clavicle are now visible, viz., the supra-scapular 25, and the small nerve to the subclavius; the rest of this set of branches are shown in Plate xv. (p. 145).

DESCRIPTION OF PLATE XXV.

A side view of the pharynx with its muscles is depicted in this Figure.

For the dissection the base of the skull is to be cut through behind the attachment of the pharynx; and the fore part of the head being fixed on a block the pharynx may be distended with tow, and the muscles will be easily prepared.

* In this body the fifth and the fourth cervical came in front of the anterior scalenus.

THE PHARYNX AND ITS MUSCLES.

The pharynx is the upper part of the alimentary tube which is placed behind the nose, mouth, and larynx. Both the food and air pass along it. It reaches from the skull to the lower end of the larynx, gradually tapering from above down, and measures from five to six inches in length. Above it is inserted into the skull by a thin fibrous membrane called the aponeurosis of attachment of the pharynx; and in front it is fixed to the head, the hyoid bone, and the larynx.

In the wall of the pharynx are contained constricting and elevating muscles, which are employed in swallowing; the latter are engaged in placing the receiving bag in the position required for the entrance of the food or drink, and the former urge onwards to the gullet the morsel received.

A. Inferior constrictor.
B. Middle constrictor.
C. Superior constrictor.
D. Stylo-pharyngeus.
E. Levator palati.
F. Tensor palati.
G. Buccinator.
H. Stylo-glossus, cut.
I. Temporal muscle.
J. Mylo-hyoideus.
K. Sterno-thyroideus.
L. Omo-hyoideus.
M. Hyo-glossus.
N. Thyro-hyoideus.
O. Stylo-hyoid ligament, ossified.
P. Sterno thyroideus.
Q. Crico-thyroideus.
R. Thyroid body, thrown down.
S. Œsophagus or gullet.
T. Trachea or windpipe.
† Pterygo-maxillary ligament.

The *constrictor muscles* are flat and thin, and are three in number on each side, viz. lower, middle, and upper. They are attached in front to the larynx, hyoid bone, and the head, and meet their fellows in the middle line behind: their contiguous edges overlap like scales, the upper being more superficial.

The *lower constrictor*, A (laryngo-pharyngeus) arises from the side of the cricoid and thyroid cartilages of the larynx; and the fibres end in the middle line behind. Its upper edge overlays the middle constrictor B, and the lower is continuous with the circular fibres of the œsophagus.

The *middle constrictor*, B, (hyo-pharyngeus) is connected in front with the hyoid bone, viz. with the great and small cornua,

and with the lower end of the stylo-hyoid ligament, O. The fibres radiate to their ending at the middle line behind, the lower passing beneath the inferior constrictor, and the upper over the superior constrictor to within an inch of the skull.

The *upper constrictor*, C, (cephalo-pharyngeus) is fixed by its anterior edge to the following parts:—to the pterygoid plate (lower third of the inner surface) and the hamular process, to the pterygo-maxillary ligament, †, to the lower jaw behind the last molar tooth, and to the floor of the mouth and the side of the tongue. As the fibres pass back to the middle line, the upper form a free curved border below the skull, where the levator palati muscle E enters above it; and the lower are continued beneath the middle constrictor, and blend with fibres of the stylo-pharyngeus.

When these muscles contract, they diminish the size of the pharyngeal cavity by bringing forwards the loose hinder part. In swallowing, the two lowest grasp and convey onwards by successive rapid contractions the morsel of food or the drink; whilst the upper one which is placed above the aperture of the mouth takes little share in the process, farther than by lessening the space above the mouth, it so far assists in opposing the ascent of the food behind the soft palate. As the tonsil is covered by the upper constrictor opposite the angle of the lower jaw, it may be compressed during the action of that muscle.

Elevators of the pharynx. Two muscles on each side, an external and an internal elevator, descend from the head to raise the upper part of the pharynx preparatory to swallowing.

The *levator pharyngis externus*, D, (stylo-pharyngeus) arises from the root of the styloid process, and descends, becoming wider, between the upper and middle constrictors to be inserted in part into the upper border of the thyroid cartilage, and in part with the upper constrictor muscle.

Levator pharyngis internus (salpingo-pharyngeus) is delineated in Plate xxvi. N. It is a small muscular slip inside the pharynx, immediately beneath the mucous membrane, which arises by tendon from the end of the Eustachian tube, O, and joins below the palato-pharyngeus muscle, C.

The elevators make ready the pharynx for receiving the aliment, and they act in this way :—The large elevator draws upwards and outwards the part of the pharynx above the os hyoides, especially the part opposite the opening of the mouth, and elevates the larynx at the same time. And the small or internal elevator raises the part of the pharynx above the large elevator, which would become loose by the action of the other muscle.

Before deglutition takes place the hyoid bone is drawn forwards and upwards by its elevator muscles, giving thus increased size to the pharynx from before back, and the larynx is carried upwards and forwards at the same time under the tongue, so as to allow the opening into the windpipe to be placed in the position most favourable for its closure during the act of swallowing.

LARYNGEAL VESSELS.

Two arteries on each side supply the larnyx, and the pharynx and windpipe in part.

a. Inferior thyroid artery.
b. Laryngeal branch.
c. Thyroid branch.
d. Laryngeal branch of the upper thyroid.
e. Lingual artery.
f. Internal carotid.

The *upper laryngeal* branch, *d*, is an offset of the superior thyroid artery, and enters the larynx through the thyro-hyoid membrane: its distribution in the larynx can be traced in Plate xxvii.

The *inferior thyroid* artery, *a*, ramifies by the branch, *c*, on the under part of the thyroid body; and sends a branch, *b*, into the interior of the larynx, which is dissected with the other laryngeal artery.

NERVES OF THE LARYNX.

Three of the nerves now apparent belong to the larynx and its muscles, and the remaining three enter the tongue.

1. Glosso pharyngeal nerve.
2. Gustatory nerve.
3. Hypoglossal nerve.
4. Upper laryngeal nerve.
6. External laryngeal nerve.
7. Recurrent laryngeal nerve.

The *upper laryngeal* nerve, 4, enters the larynx through the thyro-hyoid membrane with its artery, and ends in the mucous membrane.

The external laryngeal, 6, arises from the preceding high in the neck, and is distributed outside the larynx to the crico-thyroid muscle, Q, and to the inferior constrictor A ; and as it is the only nerve reaching this laryngeal muscle, it must give to the fibres sensibility and contractility.

The *inferior laryngeal* or recurrent nerve, 7, a branch of the vagus, ascends between the gullet and the windpipe, and passes under the inferior constrictor to supply the muscles of the larynx (Plate xxvii.). Muscular offsets are furnished by it to the two tubes between which it lies.

DESCRIPTION OF PLATE XXVI.

The interior of the pharynx, and the dissection of the muscles of the soft palate, are comprised in this Illustration.

The objects inside the pharynx will appear on slitting down the tube behind, and everting the edges: and the muscles of the soft palate will be laid bare by removing the mucous membrane on the left side, and that layer with some muscular fibres under it on the right, in the manner indicated.

INTERIOR OF THE PHARYNX.

The pharyngeal cavity reaches from the base of the skull to the lower edge of the cricoid cartilage of the larynx, and tapers from above down. At its middle it serves as a common passage

for the air and food, but the upper part transmits air exclusively, and the lower part conveys only food. These three regions, differing thus in their use, have the following limits:—the upper reaches as low as the opening of the mouth, M, and communicates with the cavities of the nose and tympanum; the middle region extends from the mouth to the aperture of the larynx V; and the third portion lies beyond the larynx, and is continuous below with the œsophagus W. Along the front of the pharynx are seven openings.

A. Tube of the œsophagus.
B. Pharynx cut, and reflected.
C. Inner part of pharynx covered by mucous membrane.
D. Septum nasi.
E. Lower spongy bone.
F. Eustachian tube.
I. Buccinator muscle.
K. Soft palate.
M. Roof of the mouth.
N. Salpingo-pharyngeus muscle.
O. The uvula.
P. Anterior pillar of the palate.
Q. The tonsil.
R. Posterior pillar of the palate.
S. The tongue.
T. The epiglottis.
V. Upper opening of the larynx.
W. Opening of the œsophagus.
X. Internal pterygoid muscle.
Z. Mylo-hyoid muscle.

The *Eustachian tube*, F, one on each side, lies close to the base of the skull; on the right side the mucous membrane has been removed from the lower end. Its extremity in the pharynx is cartilaginous and membranous, and is dilatable, but the upper part is osseous, and is contained in the temporal bone. At its lower end the cartilage is enlarged, but more at the inner than the outer side, and gives to the tube a funnel-shaped opening. The pharyngeal aperture is oval from before back, and is placed close behind the internal pterygoid plate, to which the tube is united by fibrous tissue higher up; it is on a level with the inferior meatus, the upper part of the opening reaching as high as the upper border of the lower spongy bone.

This tube leads from the pharynx to the middle ear or tympanum; it transmits air to the ear cavity, and allows the mucus of that space to escape through it. Ordinarily the lower end is closed, and the air is shut in the tympanum, but the pharyngeal opening can be rendered patent by the action of the palate muscles, so as to permit an exchange of air. An instrument can be passed into it through the nose for the purpose of

removing obstruction in the tube, or of conveying air into the tympanum.

The *posterior nares* are the apertures of communication between the two sides of the nose cavity and the pharynx. Each is elongated from above down, and will admit readily the tip of the finger. In the dried skull it is bounded by the vomer internally and the internal pterygoid plate externally, and by the body of the sphenoid above and the palate bone below; but in the fresh state the bones are clothed by the mucous membrane, though without much diminution in the size of the opening. Separating the two is the septum nasi, D.

These apertures allow the air to pass in and out when the mouth is closed. Each is very much larger than the opening in the face of the same side of the nasal cavity; and its increased size will be of use in communicating with the upper part of the nose, and in allowing the outgoing air to ascend towards the roof of the space, and warm the parts that have been cooled in inspiration.

When the mouth is spasmodically closed, liquid food can be passed into the stomach by a small flexible tube introduced through the nose and the posterior naris into the pharynx.

In hæmorrhage from the half of the nose the fluid may escape by the face, or by the posterior naris; or by both those openings when the flow of blood is great; and it may be needful to check the loss of blood by stopping up the openings. The aperture in the face can be closed easily; but the posterior naris will have to be plugged through the mouth.

The posterior opening of the mouth, M, is named *isthmus faucium*, and has the following bounds:—Below lies the tongue, S; and above are the soft palate, K, and the uvula. On each side is placed the anterior arch of the palate, P, consisting of a fold of mucous membrane with fibres of the palato-glossus muscle: these folds of opposite sides constitute the pillars of the fauces.

The opening marks the boundary line between the mouth and the pharynx, and all voluntary control over the morsel to be swallowed ceases at that spot. The anterior palatine arches on the sides of the aperture take part in the process of deglutition in

this way :—as soon as the food has been moved backwards by the tongue to the isthmus, the lateral prominences are shortened and moved inwards by the contraction of their contained muscular fibres, and shut off with the tongue the cavity of the mouth.

Upper aperture of the larynx, V.—This is a single opening, and it occupies the middle line just below the mouth. Wide before and narrow behind it is sloped down and back; it extends upwards rather above the hyoid bone, and downwards to the level of the central notch in the front of the thyroid cartilage. In front it is bounded by the wide expanded part of the epiglottis, T, and behind by the tips of the cornicula laryngis, and by the arytænoideus muscle and the mucous membrane. Laterally it is limited by a fold of mucous membrane (arytæno-epiglottidean) which stretches from the epiglottis to the arytænoid cartilage, and contains the depressor muscle of the epiglottis.

Through this hole the air is inspired and expired in breathing; and during the respiratory act the space remains wide open with the epiglottis raised.

When deglutition is about to take place the larynx is moved upwards and forwards under the hyoid bone and the tongue, and the epiglottis is partly lowered; and during swallowing the epiglottis is placed over the orifice, so as to close it from the passing food or drink, whilst the muscular fibres on the sides and back of the opening contract, and give increased security against the entrance of the aliment into the windpipe. Even when the epiglottis is absent the food does not find its way into the air passage, because the upper part is sufficiently closed by the elevation of the larynx, and by the contraction of the muscular fibres around the upper opening and on each side of the passage lower down. If an attempt is made to take breath during, or too soon after a long draught, some of the fluid is drawn with the air under the partially-raised valve, and produces violent coughing from irritation of the larynx.

The *aperture of the œsophagus*, W, terminates inferiorly the cavity of the pharynx, and is placed opposite the lower edge of the cricoid cartilage: it is circular in form, and is surrounded by the fibres of the lower constrictor.

THE SOFT PALATE AND THE TONSIL.

The *soft palate* (velum pendulum palati) forms the loose and moveable part of the roof of the mouth, and depends between the nose and mouth cavities. In a state of rest it hangs like a curtain behind the mouth, but it can be moved backwards by muscles to the wall of the pharynx, so as to act like a valve in separating the upper from the middle region of the pharynx.

It is attached above by an aponeurosis to the back of the hard palate; and it is constructed chiefly of muscles covered by mucous membrane. Laterally it is blended with the sides of the pharynx. At the lower edge it is free; and from its centre hangs a rounded elongated part, the uvula, O; whilst on each side two folds, the arches of the soft palate, are continued downwards from it.

The *arches* of the half of the *soft palate*, P and R, begin above near the middle of the velum, and descend on the sides of the tonsil, Q, diverging from each other. The anterior, P, is continued in front of the tonsil to the side of the tongue near the base; and the posterior is directed behind the tonsil to the back of the pharynx. Each consists of a fold of mucous membrane enclosing muscular fibres: in the anterior fold is the palato-glossus muscle, and in the posterior lies the palato-pharyngeus.

Tonsil, Q. This body is an aggregate of ten to twenty follicular glands, like those over the root of the tongue (Kölliker), and it occupies the interval between the arches of the palate. Its size varies much. Its situation is marked by the presence of small holes in the mucous membrane, without any surface-prominence; but when enlarged from disease it projects, diminishing thus the size of the isthmus of the fauces, and forms a swelling which may be felt externally near the angle of the jaw.

In its structure it resembles the follicular glands. In the bottom of the holes or depressions on the surface of the mucous membrane, are smaller apertures leading into recesses or follicles, which are lined by mucous membrane, and are set round with closed capsules filled with a grayish fluid, and containing

cells, and bodies like free nuclei. The capsules do not appear to have any apertures.

MUSCLES OF THE SOFT PALATE.

The muscles of the soft palate act as elevators and depressors. They are four in number on each side; and along the centre lies a thin fleshy slip, which is connected with the uvula.

G. Levator palati muscle.
H. Tensor palati muscle.
J. Azygos uvulæ muscle.
K. Superficial part of the palato-pharyngeus.
L. Deep part of palato-pharyngeus.

The *elevator muscles*, two in number on each side, G and H, descend from the base of the skull, and enter below the soft palate.

The *levator palati*, G, arises from the under surface of the apex of the temporal bone, and from the hinder part of the cartilage of the Eustachian tube; entering the pharynx above the upper constrictor (Plate xxiv.) it spreads out in the soft palate, forming a fleshy layer from the attached to the free edge, and unites with its fellow along the middle line.

This muscle contracting carries backwards and upwards the soft palate, placing this in a more horizontal position, and approaching the free edge and the uvula to the back of the pharynx. By that movement the part of the pharynx leading to the nose is much diminished; and if the upper constrictor muscle contracts at the same time the passage may be closed.

The *tensor vel circumflexus palati*, H, has a thin but wide origin from the skull, and from the fore part of the cartilage of the Eustachian tube — the cranial attachment reaching from the navicular fossa at the root of the internal pterygoid plate to the styloid process. Descending along the inner pterygoid plate, the muscle enters the pharynx between two points of attachment of the buccinator muscle (Plate xxiv.) and becoming tendinous, turns round the hamular process to be inserted partly into the os palati, and partly into the aponeurosis of the palate beneath

the muscles L and G. A small bursa exists where the tendon plays round the bone.

As this muscle is attached to the immoveable hard palate its action must be more limited than that of the levator; it may assist the special elevator in bringing the side of the soft palate into a more horizontal position, and it will then fix and render tense the same part of the palate.

The two muscles above described are connected with the cartilaginous part of the Eustachian tube, and may act on it. Taking their fixed point below, they are enabled to open that tube which is ordinarily closed, and so to permit air to enter the cavity of the tympanum. During swallowing, and during forced expiration with the mouth and nose apertures closed, they act in the manner indicated; but some persons have the power of opening at will the Eustachian tube, and driving air in expiration into the tympanic cavity, without the nostrils being stopped.

Azygos uvulæ, J.—This slender muscle shortens the uvula and the middle part of the soft palate, and assists therefore the elevators. It consists of two slips of pale muscular fibres, (only the right is seen,) which arise above from the palate spine and the aponeurosis of the soft palate, and are inserted below into the uvula.

The *depressors* of the soft palate, two in number on each side, are directed downwards in the folds of the arches of the palate to the tongue and the thyroid cartilage.

The *palato-glossus* (constrictor isthmi faucium) lies in the anterior pillar, P. It is a thin narrow slip, which begins on the front of the soft palate, where it joins its fellow in the middle line; and ends on the side and dorsum of the tongue, as is shown in Plate xxvii.

If the lower end is fixed it can draw down the soft palate, stretching the same, so as to diminish the space between the tongue and the palate; and if both ends are fixed the muscle will be moved inwards towards its fellow, narrowing the isthmus of the fauces, as when a morsel of food is about to be swallowed.

The *palato-pharyngeus* is larger than the preceding and consists

of two layers in the palate, which are separated by the levator palati and azygos uvulæ muscles.

The superficial thin layer, K, is close beneath the mucous membrane, and joins at the middle line the muscle of the other side. The deeper and stronger layer, L, unites with its fellow internally, whilst some of the upper fibres are fixed to the aponeurosis of the palate. Both layers meet at the outer border of the palate, and descend behind the tonsil in the fold, R, to be inserted into the back of the thyroid cartilage, but a part blends in the pharynx with the upper constrictor.

Acting from below the muscle will bring down the arch, R, and will approach the same to the uvula : it will also draw down and back the soft palate towards the pharynx.

The soft palate from its position and its power of moving plays an important part in breathing, in the use of the blow-pipe, in swallowing, and in vomiting.

In breathing with the mouth open the air may pass through both mouth and nose, or only through the nose, according to the position of the moveable palate. When the air obtains ingress and egress through both cavities at the same time the velum hangs vertically, as in the Drawing, and leaves a space between it and the tongue. When the air is transmitted only through the nose, the palate is applied to the back of the tongue, and shuts off the channel of the mouth.

During the use of a blow-pipe the mouth is first filled with air, and the soft palate is then applied to the back of the tongue to close the mouth behind, whilst the cheek-muscles force out from the oral space through the lips a continuous current of air. At intervals, however, the palate is raised temporarily during expiration for the purpose of refilling with air the cavity of the mouth.

In deglutition the soft palate directs the aliment into its downward channel. As soon as the morsel to be swallowed has reached the back of the tongue the moveable palate is raised, and is arched over it so as to prevent its taking an upward direction towards the nose. The depressor muscles contracting at the same time keep the flap fixed, and prevent its retroversion; and as the

palato-glossus muscle moves inwards behind the morsel, barring with the tongue its return to the mouth, whilst the palato-pharyngeus forms with the uvula an inclined plane above it, the bolus is conveyed into the pharynx.

In vomiting the aliment takes a retrograde course from the stomach through the mouth; and the moveable palate is used as a valve to shut off the upper region of the pharynx and the nose. The position of the velum during this act is similar to that occupied by it in deglutition, viz., it is moved somewhat horizontally backwards towards the wall of the pharynx, and the palato-pharyngei with the contracted uvula between them form behind an inclined plane. The soft palate is not capable however of blocking up entirely the tube of the pharynx, for some of the ejected matter is forced by it into the nose cavity.

The influence of the soft palate on the voice seems to be small, though it forms part of the winding passage through which the sound is transmitted after its production by the vocal cords in the larynx. In the high notes in singing the palatine arches and the uvula are contracted, but touching them does not produce alteration of the note: this tense state has been thought to increase the resonance of the voice.

VESSELS AND NERVES.

The vessels and nerves appearing in this dissection have been noticed in the description of the preceding Plates.

a. Ending of the external carotid artery.
b. Temporal artery.
c. Internal maxillary artery.
d. Internal carotid artery.
e. Inferior laryngeal branch.

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1. Gustatory nerve.
2. Recurrent laryngeal nerve.

DESCRIPTION OF PLATE XXVII.

Figures ii. and iii. show the cartilages and ligaments of the larynx, with the vocal apparatus; and in Figure i. the muscles, vessels, and nerves are displayed.

In the preparation made for Figure ii., the muscles were removed, and the right half of the thyroid cartilage was cut off, except the fore part and the lower cornu; and then the muscles and the mucous membrane beneath the cartilage were taken away to lay bare the vocal cord, and the arytænoid cartilage of the same side.

Figure iii. exhibits the interior of the air passage on a larynx and windpipe slit down behind.

HYOID BONE AND THE CARTILAGES OF THE LARYNX.

The cartilages of the larynx can be studied with the aid of Figures ii. and iii.; and like parts in both Drawings are marked by the same letters of reference.

A. Great cornu of the hyoid bone.
B. Body of the os hyoides.
C. Small cornu of the hyoid.
D. Thyroid cartilage.
E. Upper cornu of the thyroid.
F. Lower cornu of the thyroid.
G. Cricoid cartilage.
H. Arytænoid cartilage.
I. Cartilage of Santorini.
J. Crico-arytænoideus posticus muscle.
K. Cuneiform cartilage.
L. Epiglottis.
M. Thyro-hyoid ligament.
N. Crico-thyroid ligament.
O. True chorda vocalis.
P. False chorda vocalis.
Q. Ventricle of the larynx.
R. Rima glottidis.
S. Sacculus laryngis.
T. Thyro-hyoid membrane.
U. Arytæno-epiglottid fold.
V. Arytænoideus posticus muscle.
W. Interior of the trachea.
X. Muscular part of the trachea.
Y. Rings of the trachea.

The *hyoid* or U-shaped *bone* is placed between the tongue and the larynx, to both of which it gives attachment. It consists of a

central part or body, and of two lateral pieces on each side—the cornua.

The body, B, is the deepest part of the bone: it is convex and uneven in front, and concave and smooth behind. Elevator and depressor muscles are fixed into the fore part; and by its upper edge its gives attachment to the fibrous membrane of the tongue, and to that of the larynx.

The cornua articulate with each side of the body. The large one, A, projects backwards behind the tongue, and is joined by muscles of the pharynx, larynx, and tongue. The small cornu, C, is a short rounded process, to which the stylo-hyoid ligament (X, Fig. i.) is connected.

Cartilages of the larynx. There are several pieces of cartilage in the larynx as in the trachea; but they differ in their nature. One set resembles the permanent cartilages of the ribs, and like them is prone to ossify; the other set, consisting of small pieces, is constructed of yellow cartilage, as in the eyelid, and is not transmuted into bone.

The large and firm cartilages, which are more or less ossified in the adult, are more immediately connected with the vocal cords: they are four in number, viz., the thyroid, cricoid, and two arytænoid.

The *thyroid* cartilage, D, is the largest and highest, and is named from protecting the rest like a shield. It is formed of two similar halves, which are widely separated behind, and are united in front at an acute angle, so as to be prominent beneath the skin (pomum Adami).

Each half ends posteriorly in a rounded thickened border, which is prolonged above and below into a point—the cornua: of these, the upper cornu, E, is the longest, and the lower one, F, articulates with the cricoid cartilage.

Externally muscles of the pharynx and larynx are fixed into the thyroid; and internally it receives the insertion of the vocal cords and of muscles acting on those cords.

The *cricoid* cartilage, G, forms a ring around the air passage, and is much deeper behind than before, like a signet ring. On its upper border at the back are seated the two arytænoid carti-

lages; and outside and below these the lower cornua of the thyroid cartilage rest on it. Internally it is smooth and is lined by mucous membrane; and externally muscles are attached to it.

The part of the larynx enclosed by this cartilage is quite inextensible; and by means of the great depth of the cricoid behind the arytænoid cartilages are raised to the height needful for the attachment of the vocal cords to them.

The *arytænoid* cartilages are something like a pitcher in shape, and are placed at the back of the larynx. Each is pyramidal in form, with the base resting on the upper border of the cricoid cartilage, and the apex blending with the cartilage of Santorini, I. Narrow and smooth internally or towards its fellow, it is widened and rough externally where muscles are inserted into it, Fig. ii., H. Its posterior part is hollowed, and lodges the arytænoid muscle; and from its fore part projects a spur into which the vocal cord, O, is fixed.

This is the most moveable of the laryngeal cartilages; and as the vocal cord and most of the muscles altering the condition of that cord are connected with it, the production and modification of the voice are influenced by its position.

The remaining small cartilages do not take part in the production of the voice, though they may assist in modifying the same after it is formed, and they are therefore of secondary import. Five in number, the chief of them acts as a valve to the upper opening of the larynx, and is called epiglottis: the others are two pairs, one being named cartilages of Santorini, and the second, cartilages of Wrisberg.

The *cartilages of Santorini*, I, (cornicula laryngis) are placed on the tops of the arytænoid cartilages. Wide below they gradually taper above, the points bending towards each other.

They bound posteriorly the upper laryngeal opening; and, enveloped by the mucous membrane, serve for the attachment of the folds, U, bounding laterally that opening.

The *cartilages of Wrisberg*, K, Fig. ii. (cuneiform cartilages), are placed in front of the cornicula one in each arytæno-epiglottid fold U. Each resembles a grain of rice in shape and size. The

use of these is not known : they are not connected to the other cartilages by ligamentous bands.

The *epiglottis*, L, stands in front of the opening into the larynx (Plate xxvi.). Shaped like a leaf, with the wide part up and the pedicle down, it is attached by fibrous tissue to the thyroid cartilage. Its hinder or laryngeal surface has a smooth covering of mucous membrane with apertures for glands in its substance; and the fore part is connected to the tongue by a central and two lateral folds of mucous membrane. From each side is continued the arytæno-epiglottid fold.

This valve is employed in closing the laryngeal opening during deglutition (p. 212). And when placed over the opening during the production of vocal sounds it causes the pitch of the note to be lowered.

ARTICULATIONS OF THE CARTILAGES.

The larger laryngeal cartilages are articulated together by means of joints where the extent of movement is great; and the larynx is further united to the hyoid bone above and the trachea below by fibrous membrane.

The *cricoid* and *thyroid cartilages* are articulated at two points, viz., laterally and in front.

Laterally there is a joint on each side between the lower cornu, F, of the thyroid and the side of the cricoid, in which an enclosing capsule and a lining synovial membrane are present. By means of this joint the front of the thyroid cartilage can be approximated to or removed from the cricoid. When the thyroid is depressed the vocal cords are tightened, and when it is raised or carried backwards they are relaxed.

Anteriorly a strong elastic membrane, *crico-thyroid*, N, closes the interval between the two. By its lower edge it is inserted into the upper border of the cricoid as far back as the arytænoid cartilage; and above it joins the lower border of the thyroid for a short distance, also the spur on the front of the arytænoid, and between those fixed points it forms a free edge, O, the vocal cord. This free upper edge can be tightened or rendered lax by the thyroid cartilage being depressed or raised.

thyroid cartilage about the centre of its vertical depth, and behind into the spur at the base of the arytænoid cartilage. In the male it measures rather more than half an inch, and in the female rather less. This band forms the upper free edge of the crico-thyroid ligament (Fig. ii., N), and consists of a bundle of fine elastic tissue covered by thin mucous membrane.

It has two free surfaces, one internal which looks to its fellow, and one above where it bounds the ventricle ; and the free edge between those two surfaces is the part that is made to vibrate by the outgoing current of air.

Sound or voice is produced by the expired air throwing into vibration the free edges of the two lower vocal cords. In ordinary breathing the vibrating edges are at a distance from each other, and divergent behind, and the air passes by them without sound ; and in order that voice should be produced those edges require to be approximated and put parallel to each other by muscles, and so to be brought into the state called the vocalizing position.

The pitch of the voice varies with the degree of tightness or laxness of the vocal cords. If the cords are loose a deep sound ensues, but if they are tight, a high tone is formed. Alterations in the degree of tension depend upon the action of controlling muscles.

The *glottis* (rima glottidis), R, is the narrow interval or chink between the true vocal cords. Its extent is greater than that of the cords, for it reaches across the larynx ; and it is bounded on each side by the vocal cord and the arytænoid cartilage. It measures from before back nearly an inch, and across at the base when dilated about a third of an inch : both measurements refer to the larynx of the male. In the female the size is less by two or three lines. During inspiration the space is larger than in expiration.

Its form changes with the dilatation. In a state of rest the interval resembles a spear-head with the shaft placed backwards ; when dilated it is triangular in form, the base of the interval being behind.

The *ventricle* of the *larynx*, Q, is the hollow between the false and true vocal cords of the same side ; and it extends from the

thyroid to the arytænoid cartilage. The bottom of the hollow is wider than the opening into the larynx ; and at its upper and anterior part it communicates with the sacculus laryngis, S. Into this hollow the mucous membrane sinks, and lining the same enters the laryngeal pouch.

This space by its position isolates the true vocal cord from the wall of the larynx, and permits the free vibration of that band.

The laryngeal pouch (sacculus laryngis), S, is a small conical bag of the mucous membrane, which projects upwards from the ventricle of the larynx, and when distended reaches as high as the upper border of the thyroid cartilage. Fig. ii. gives an inner view of its position on the side of the epiglottis ; and in Fig. i. it is seen from the outside as it rises above the thyro-arytænoid muscle, P.

Closed and dilated above, it is narrow below ; and it opens into the ventricle by a small hole, which is diminished somewhat by a projection of the mucous membrane. Over the outer surface are scattered numerous mucous glands (sixty or seventy in number) which open by small ducts on the inner surface, and pour their secretion over the contiguous parts—viz., the ventricle and the vocal cords.

The *mucous lining* of the larynx forms a fold, U, (arytæno-epiglottid,) on each side of the upper orifice, and extends through the cavity to the trachea. Furnishing a very thin covering without glands to the vocal cords, it sinks into the ventricle between them, and gives rise to the sacculus. As low as the vocal cords it is loosely united to the subjacent parts by areolar tissue, but it is joined closely to those bands without the intervention of any submucous stratum. In consequence of the closeness of its attachment to the cords the swelling from fluid effused into the areolar tissue in œdema of the glottis does not extend below that point. And thus, though the upper orifice of the larynx may be closed by the swelling, air may be admitted to the lungs by an artificial aperture through the crico-thyroid membrane, N, as in the operation of laryngotomy, because this opening will be situate below the swollen parts.

FIGURE I.—For this Drawing the dissection was prepared by removing the greater part of the right half of the thyroid cartilage, and then taking the areolar tissue from the subjacent muscles, vessels, and nerves. Some nerves which enter the mucous membrane behind the larynx from both laryngeal trunks could not be preserved.

On the right side of the tongue the extrinsic muscles have been defined as they enter it.

In this, as in the other Figures, the hyoid bone, the cartilages of the larynx with some ligaments, and the trachea and the thyroid body are depicted.

A. Os hyoides.
B. Thyroid cartilage.
C. Cricoid cartilage.
D. Trachea.
E. The tongue.
F. Palato-glossus muscle.
G. Stylo-glossus.
H. Pharyngeo-glossus.
I. Cornicula laryngis.
J. Crico-thyroid membrane.
K. Hyo-glossus muscle.
L. The epiglottis.
M. Genio-hyo-glossus.
N. Thyro-hyoid membrane.
S. Sacculus laryngis.
T. Thyroid body.
U. Pyramid of the thyroid body.
W. Levator glandulæ thyreoideæ.
X. Stylo-hyoid ligament, ossified.
Z. Upper part of the œsophagus.

MUSCLES OF THE LARYNX.

Some of the intrinsic laryngeal muscles act more immediately on the arytænoid cartilages, approximating them to, or removing them from each other; and control the width of the glottis. Others make tense or lax the vocal cords, and so govern the pitch of the voice. One pair of muscles depresses the epiglottis.

O. Depressor of the epiglottis.
P. Thyro-arytænoideus.
Q. Crico-arytænoideus lateralis.
R. Crico-arytænoideus posticus.
V. Arytænoideus.
Y. Crico-thyroideus, cut.

Muscles governing the size of the glottis.—The interval between the vocal cords can be widened or narrowed by the three following muscles.

The *crico-arytænoideus posticus*, R, (J, Fig. iii.) arises from the right lateral depression on the back of the cricoid cartilage, and is inserted above into the base of the arytænoid cartilage at the outer side.

When this muscle acts the arytænoid cartilage will be rotated around its vertical axis, and the anterior spur will be moved outwards away from the middle line. By this movement the glottis is widened at the base, and the upper aperture of the larynx is also made larger.

The *crico-arytænoideus lateralis*, Q, arises from the upper edge of the cricoid cartilage at the lateral aspect; and taking a backward direction it is inserted with the preceding into the external prominence at the base of the arytænoid cartilage, and into the contiguous part of the outer surface.

As the preceding muscle rotates outwards the external projection of the cartilage, the lateral crico-arytænoideus is put on the stretch; but as soon as the posterior muscle ceases to contract, the lateral one will restore the displaced cartilage to its usual position. This muscle, acting by itself, will turn inwards the anterior spur, and diminish the width of the glottis.

The *arytænoideus*, V, the only single muscle of the larynx, closes the interval between the arytænoid cartilages. It consists mostly of transverse fibres, which are attached to the hollowed posterior surfaces of the cartilages; also of two superficial bands which are directed from the base of one cartilage to the apex of the other. These oblique slips cross each other at the middle, and join in front the thyro-arytænoideus and the depressor epiglottidis.

The fibres of the muscle contracting will draw the arytænoid cartilages towards each other, and diminish the width of the glottis. And, as this movement approximates the vocal cords, the muscle is one of the two employed in placing the cords in the vocalizing position. The muscle diminishes behind the width of the upper laryngeal orifice.

Muscles governing the pitch of the voice.—The muscles making tight or loose the vocal cords, and rendering the voice either high or deep in tone, are the two subjoined.

The *thyro-arytænoideus* muscle, P, lies outside the vocal cord of the same side, to which it is closely united. Anteriorly it arises from the lower half (in depth) of the thyroid cartilage, and from the contiguous crico-thyroid membrane; and it is inserted behind into the base and outer surface of the arytænoid cartilage. Its inner and lower fibres are transverse, but the outer ascend and join the depressor of the epiglottis, O.

Through the action of this muscle the arytænoid will be drawn forwards towards the thyroid cartilage, and the vocal cord of the same side will be relaxed, as when deep or grave sounds are produced. The muscle is supposed (Willis) to have the power of placing the inner vibrating edge of the vocal cord parallel to its fellow.

The *crico-thyroid* muscle, Y, can be seen entire in Plate xxiv. Placed on the front of the larynx, it arises from the side and fore part of the cricoid cartilage; and it is inserted into the inferior cornu, and the lower border of the thyroid cartilage nearly to the middle line.

Supposing the attachment to the cricoid cartilage to be the fixed point, the muscles of opposite sides will bring down the thyroid cartilage in front. By this movement the interval between the arytænoid and thyroid cartilages is increased, and consequently the vocal cords are tightened, and put into the state necessary for the production of a high note. If the thyroid is supposed the fixed point the front of the cricoid will be raised, whilst the back with the arytænoid cartilages will be lowered, and the vocal cords will be likewise stretched.

The *depressor of the epiglottis*, O, (thyro-arytæno-epiglottideus) is a thin and indistinct layer of muscular fibres, which is contained in the arytæno-epiglottid fold, U, and consists usually of two parts. The chief bundle of fibres comes from the top of the arytænoid cartilage, where it is continuous with the thyro-arytænoideus and arytænoideus muscles; and the other slip is attached to the thyroid cartilage near the insertion of the epiglottis. The fibres of the muscle ascend on the side of the opening of the larynx, and are inserted into the margin of the epiglottis.

The lower fibres of the muscle cross the top of the sacculus

laryngis, and are supposed by Mr. Hilton to compress the sac: this part has been named by him *arytæno-epiglottideus inferior.**

In swallowing the epiglottis may be lowered by the action of the muscles of both sides, after the larynx has been elevated; and the laryngeal orifice can be diminished by the shortening and moving inwards of the arytæno-epiglottid fold. In the production of very deep notes the muscles draw down the epiglottis over the aperture of the larynx.

NERVES OF THE LARYNX.

There are two laryngeal nerves on each side, the superior and inferior. One is supplied nearly altogether to the mucous membrane, and the other chiefly to muscles.

1. Upper laryngeal nerve.
2. Branches to the mucous membrane of the larynx.
3. Branch for the arytænoideus.
4. Branch to join inferior laryngeal.
5. Inferior laryngeal or recurrent nerve.
6. Branch to join upper laryngeal.
7. Branch to muscles.
8. Hypoglossal nerve.
9. Glosso-pharyngeal nerve.
10. Gustatory nerve.

The *upper laryngeal* nerve, 1, pierces the thyro-hyoid membrane, and divides into branches. From the branch, 2, offsets are distributed to the root of the tongue, and to the mucous membrane of the larynx; between the border of the epiglottis and the true vocal cord, one or two pierce the depressor of the epiglottis. The branch 3 enters the arytænoideus muscle, V, and supplying it, passes through to the mucous lining of the larynx. From the branch, 4, offsets are furnished to the pharyngeal mucous membrane; and this joins finally the recurrent laryngeal nerve.

Before the nerve enters the larynx it gives off high in the neck the external laryngeal branch (Plate xxiv. 4), which ends in the crico-thyroideus muscle, Y, supplying it entirely.

The upper laryngeal is the sensory nerve of the mucous mem-

* Description of the sacculus or pouch in the human larynx. By Mr. John Hilton. Guy's Hospital Reports, vol. 2. Lond. 1837, p. 519.

brane of the larynx as low as the true vocal cord; and by its extreme sensibility it guards the upper part of the passage against the entrance of anything but the air. As soon as a particle of food or drink touches the lining membrane the respiratory muscles are called into play by a reflex act. and the foreign body is expelled by coughing. In the attempt to breathe an irrespirable gas the passage is closed by the contraction of the surrounding muscles, also through a reflex act. When the nerve is cut across in an animal during life the sensibility of the part is lost. and food may enter the larynx.

To the crico-thyroideus muscle, which it supplies alone, it gives motor power as well as sensibility; and to the arytænoideus, to which with the recurrent it furnishes offsets, it imparts only sensibility.

The *inferior laryngeal* or recurrent nerve, 5. ascends over the side of the cricoid cartilage, and ends in muscular offsets beneath the thyroid. At first the nerve supplies branches to the mucous membrane of the pharynx, and the communicating branch, 6. which joins the upper laryngeal under the thyroid cartilage. The continuation of the nerve, 7, then terminates in branches for muscles:—one belongs to the crico-arytænoideus posticus, R; a second, which passes beneath the cric.-arytæn. post., enters the arytænoideus, V; and another gives nerves to the crico-arytænoideus lateralis, Q, and the thyro-arytænoideus, P. In short the nerve supplies all the special laryngeal muscles except the crico-thyroideus, Y, which receives the external laryngeal branch of the superior laryngeal nerve.*

The recurrent is the motor nerve of the muscles acting on the

* Anatomists are silent for the most part respecting the nerve to the muscle here called depressor of the epiglottis; but Mr. Hilton states (Guy's Hospital Reports, vol. 2, 1837) as the result of "repeated and careful dissections" that it is supplied from the recurrent nerve by means of two filaments which are prolonged from the branch of the same nerve to the thyro-arytænoideus. Neither in my own dissections, nor in those of Mr. P. B. Mason, demonstrator of Anatomy, and Mr. J. S. Cluff, a distinguished student, could any separate branch be traced from the recurrent nerve to the muscle. Mr. Cluff made six special examinations of the human larynx, one of the larynx of a donkey, and one of the larynx of a cat.

vocal cords, to all of which, except to the crico-thyroideus, it gives branches. But it must bestow sensibility by means of the offsets ramifying in the mucous membrane.

If the recurrent nerves are cut through, the muscles are paralysed; and as the vocal cords cannot be placed in the vocalizing position, and cannot receive the necessary degree of laxity or tension, voice cannot be produced.

VESSELS OF THE LARYNX.

Two arteries on each side, which are companions to the nerves, ramify in the larynx; they are named upper and lower laryngeal. Other small arteries from the upper thyroid enter the larynx below by perforating the crico-thyroid membrane.

a. Upper laryngeal artery.
b. Ascending branch } of the upper artery.
c. Descending branch }
d. Communicating branch of the upper laryngeal.
e. Communicating branch of the lower laryngeal artery.
f. Muscular branch of lower laryngeal.
g. Inferior laryngeal artery.
h. Branches of superior thyroid artery to the thyroid body.
k. Branches of inferior thyroid artery to the under part of the thyroid body.

The *upper laryngeal* artery, *a*, resembles the nerve of the same name in its branches, but it is not distributed so exclusively to the mucous membrane. The offsets, *b* and *c*, supply the mucous membrane from the root of the tongue to the chorda vocalis; and from *c*, arteries are furnished to the muscles, O, P, and Q, under the thyroid cartilage, and to the crico-thyroideus, Y. The branch, *d*, anastomoses with the inferior laryngeal both under the thyroid cartilage, and in the mucous membrane of the pharynx.

The *inferior laryngeal*, *g*, gives branches to the posterior laryngeal muscles, R and V, and to Q in part; and it joins the upper laryngeal outside the thyro-arytænoideus muscle P. Branches of it enter the mucous membrane of the pharynx, and communicate again with the upper laryngeal by the offset, *e*.

Veins accompany the arteries. The upper laryngeal opens through the superior thyroid vein into the internal jugular trunk; and the lower sends its blood into the innominate vein along the inferior thyroid branch.

THE THYROID BODY AND THE TRACHEA.

In a side view, the thyroid body, T, is only partly visible. This organ is larger in the female than the male, and is more developed in the fœtus than in the adult relatively to the rest of the body: its use is not known.

It is placed opposite the upper part of the trachea; and consists of two lobes, right and left, which are firmly attached to the windpipe, and project upwards, one on each side, as far as the thyroid cartilage. A narrow part, the isthmus, joins the lobes below in front of the trachea. Each lobe is pointed above and wide below; and it lies between the larynx and the common carotid artery, where it is covered by the depressor muscles of the hyoid bone (Plate xxiv.).

Projecting upwards from the left lobe, or from the isthmus, is a small tapering part, U,—the pyramid, which is connected to the os hyoides by a band of fibrous tissue. Sometimes, as in the Drawing, a thin muscular slip, W, *levator glandulæ thyreoideæ*, unites the pyramid with the hyoid bone.

Brownish red or purplish in colour, it consists of small masses or lobules about as large as the little finger nail. It does not possess any excretory duct. On cutting into it a thick yellowish fluid escapes from small closed capsules or vesicles.

The swelling of the throat known as a wen or Derbyshire neck, is caused by hypertrophy and enlargement of the thyroid body.

Bloodvessels.—Two large arteries on each side ramify in this body. The *upper thyroid*, *h*, a branch of the external carotid, enters the apex of the lobe, but it distributes some branches over the surface, which join the other arteries. The *lower thyroid*, *k*, is usually larger than the upper, and is a branch of the subclavian trunk: it penetrates the base of the lobe, and offsets ramify over the under surface. All the arteries communicate freely together.

Three large *thyroid veins* issue on each side. Two, upper and lower thyroid, run with the arteries of the same name, and end—the former in the internal jugular, and the latter in the innominate vein. A middle thyroid vein leaves the middle of the

lobe, and crossing the common carotid artery joins the internal jugular trunk.

The *trachea* or windpipe, D, reaches from the larynx to the thorax, and divides in that cavity into two pieces or bronchi—one for each lung. Placed in front of the œsophagus, Z, along the middle line of the body, it is round and firm in front, but flat and soft behind, and is always pervious to the air. Its transverse width is about an inch in the male, but less in the female. Its fore and hinder parts differ much in their composition.

The firm fore part of the tube consists of dense fibrous membrane, which incases separate pieces of cartilage about one sixth of an inch wide, and forming three fourths of a circle. Each piece has its convexity directed forwards; and the whole keep apart the walls of the tube. Behind where the tube is flattened it is constructed by fibrous membrane (X, Fig. iii.) continuous with that containing the pieces of cartilage; and beneath it is a layer of transverse muscular fibres, together with some superficial bundles of short longitudinal fibres.

Lining the trachea is a mucous membrane covered with a columnar and ciliated epithelium; and beneath the same is a layer of elastic tissue which is collected into bundles in the flat part of the tube. Many glands are placed beneath the mucous membrane; and the largest occupy the back of the tube where some are external to the fibrous and the muscular layer.

DESCRIPTION OF PLATE XXVIII.

THESE three Figures of vertical sections of the nose will indicate the boundaries of that cavity, and the openings into it.

For Figure i., the right half of the nasal cavity was cut through vertically, and the septum nasi was removed,—the fore part of

the skull having been previously detached for the dissection of the pharynx.

The nose was sawed through on the left of the septum for Figure ii.; and pieces of the middle and inferior spongy bones were cut out to render evident the openings into the meatuses.

And for Figure iii. the mucous membrane was removed from the septum nasi, after the saw had been carried vertically through the left nasal fossa.

BOUNDARIES OF THE NASAL CAVITY.

Some of the boundaries appear in all the Figures, and the same letters of reference are used for them.

A. Middle part of the roof of the nasal fossa.
B. Fore part of the roof.
C. Back of the roof.
D. Floor of the nasal cavity.
E. Dilatation within the nostril.
F. Upper spongy bone.
G. Middle spongy bone.
H. Lower spongy bone.
I. Upper meatus of the nose.
J. Middle meatus.
K. Lower meatus.
L. Sphenoidal sinus.
M. Frontal sinus.
N. Funnel-shaped prominence of the ethmoid bone.
O. Aperture of the nasal duct.
P. Opening of the Eustachian tube.
Q. Soft palate cut through.
R. Descending plate of the ethmoid.
S. Vomer.
T. Cartilage of the septum.
U. Cartilage of the aperture.
V. Pharynx.
W. Genio-hyo-glossus muscle.
X. Epiglottis.
Y. Os hyoides.
Z. Thyroid cartilage.

Each half of the nose cavity is a flattened space, which communicates with the face and the pharynx, and with the hollows or sinuses in the surrounding bones. It intervenes between the base of the skull and the mouth, and occupies the interval between the eye sockets. The bones of the face and skull enter into its construction; and the boundaries are named roof and floor, inner and outer wall.

The floor, D, is horizontal and smooth; and its bony framework consists of the palate pieces of the upper maxillary and palate bones.

The roof reaches from the nostril to the posterior naris, and is sloped before and behind. Its centre is formed by the thin cribriform plate of the ethmoid, A, and is nearly straight; the

fore part is made up of the frontal and nasal bones, and the lateral cartilage; and the hinder part is bounded by the anterior and inferior surfaces of the body of the sphenoid, with the sphenoidal spongy and palate bones.

The inner wall is the septum or partition between the fossæ of opposite sides. In it are the descending plate of the ethmoid, R, the vomer, S, and the triangular cartilage, T.

The outer wall is marked by projecting osseous pieces with subjacent hollows, and is constructed of several bones. From before back the following is the order of succession, viz.: os nasi, upper jaw, lachrymal, ethmoid, and palate bones, with the internal pterygoid plate of the sphenoid bone. Below the nasal, in front, is found the lateral cartilage.

The width of the nasal fossa is larger below than above; and at the floor close to the septum is the greatest space available for passing an instrument through the cavity. Across the upper part of the fossa the spongy bones project, so as nearly to touch the septum. From before back the length measures about three inches along the floor, and the depth amounts to two inches at the centre.

In front is the opening called the nostril: this is an elongated hole which is surrounded except behind by the cartilage of the aperture, U, and is always open. For the distance of half an inch within the nostril is a dilatation, E, large enough to take the end of the finger, which is lined by skin provided with hairs or vibrissæ. Behind, the space communicates with the pharynx by the posterior naris (Plate xxvi.).

In breathing the air passes ordinarily through the lower half of the nasal fossa, but by sniffing, as in the attempt to recognise faint odours, the current can be directed upwards to the region where the olfactory nerve ramifies.

Through the lower part of the nasal fossa the opening of the Eustachian tube, P, can be reached. To enter that tube an instrument should have the requisite size and curve, and should be directed along the floor close to the septum until it reaches the posterior naris; then the point is to be turned upwards and outwards into the aperture. In like manner a flexible tube can be passed through

the cavity to the pharynx for the purpose of conveying liquid food into the stomach.

Blood escaping into the nasal cavity from rupture of the vessels of the mucous lining requires to be confined within the space when the loss of a fresh quantity may be injurious to health or endanger life. In closing the nasal fossa the posterior naris is stopped first by a plug inserted through the mouth in the following manner:—An elongated dossil of lint or cotton wool of the size of the opening is to have a piece of silk or small twine tied around the middle, so as to leave the ends about a foot long. Next, a bit of wire (not too stiff), with a noose at the end and rather curved downwards, is to be pushed along the floor of the nose and behind the soft palate until it can be seen through the open mouth. One of the string ends should be inserted through the noose with a pair of forceps, the other being retained in the left hand. By withdrawing the wire the string will be brought out through the nostril; and by means of that piece of string the plug can be dragged through the mouth, and round the soft palate with the aid of the left fore finger to the posterior naris. The two strings may be then tied between the nose and mouth. Finally to complete the closure of the nasal cavity the nostril is to have a plug inserted into it.

When the surgeon considers the bleeding not likely to return the plugs are to be taken away. For the removal of the anterior one the proceeding is simple, but the posterior has to be taken out through the mouth in this way:—The knot being untied, the plug is to be dislodged from its position by pulling downwards and backwards with a forceps the string in the mouth; and that body is then to be conducted round the soft palate to the exterior.

SPONGY BONES AND THE MEATUSES.

Three curved bones, Fig. i., project into the nasal cavity from the outer wall; they are named from their form spongy or turbinate; and from their position, upper, middle, and lower. These osseous pieces do not extend the whole length of the outer wall,

but are confined to a part limited by two lines continued upwards—one from the front and the other from the back of the hard palate.

The *upper spongy* bone, F, is a process of the lateral mass of the os ethmoides; and it occupies the posterior half of the interval before mentioned.

The *middle spongy* bone, G, is also a process of the ethmoid, and forms the lower curved edge of the lateral mass of that bone: usually it reaches all across the space included by the two vertical lines.

The *inferior spongy* bone, H, one of the facial bones, is larger than the others, and its length rather exceeds the limits of the space referred to.

The spongy bones are thin and brittle; and as they are convex on the inner surface and concave on the outer, channels or meatuses exist between them and the wall to which they are attached. They are covered by the mucous membrane, and afford greater surface for the ramifications of the nerves and bloodvessels.

The *meatuses*, Fig. i., are the lengthened spaces between the spongy bones and the outer wall; and they are the same in number as those bones. Occasionally there is a rudiment of a fourth space above the rest, as in Fig. ii.

The upper meatus, I, less deep and long than the others, communicates with the posterior ethmoidal cells by an aperture or apertures at the fore part (Fig. ii.).

The middle meatus, J, has several openings in it from hollows in the surrounding bones; and in Fig. ii. the middle spongy bone is represented cut through to show the apertures. At the front of the meatus is an elongated eminence, N, of the ethmoid bone, with two grooves, one before and the other behind it: the anterior groove leads upwards into the frontal sinus, M, and the posterior opens into the anterior ethmoidal cells. Close above the lower part of the prominence referred to, and midway between the letters J and N is the small round hole of the antrum maxillare.

The inferior meatus, K, receives the ductus ad nasum; and to see this the lower spongy bone will require to be cut through in front. In the dried bone the canal for the tears has a wide fun-

nel-shaped end in the meatus; but in the recent state a piece of the lining membrane of the nose is stretched over the aperture forming a valve for it, and leaves only a small oblique passage for the tears. In the Figure the size of the opening, O, is to be seen. Usually the flap closes the aperture, and prevents air from being driven out of the nose into the lachrymal canals. An instrument entering the duct from below must necessarily injure the valve.

One sinus, viz., that of the body of the sphenoid bone, L, does not open into a meatus: its aperture, which is rather large, may be seen on the slanting hinder part of the roof.

THE MUCOUS MEMBRANE AND THE BLOOD VESSELS.

The mucous membrane, named pituitary and Schneiderian, clothes the cavity, uniting with the periosteum of the bones, and joins the skin in front, and the lining of the pharynx posteriorly. It is continued over the foramina transmitting vessels and nerves into the cavity, so as to close them; but it sinks into the apertures leading into the sinuses in the surrounding bones, and lines those air spaces, whilst it diminishes somewhat the size of their openings. Through the nasal duct it is continued upwards to the lachrymal sac, and forms below a thin valve, O, which shuts the opening.

In the lower half of the nasal cavity the membrane is thick and vascular, particularly over the septum nasi and the lower spongy bone; and it increases the surface of the latter by being prolonged from the lower margin. Its epithelium is columnar and ciliated, except in the dilatation near the nostril where it joins the epidermis and is laminar: at this same spot it is provided with papillæ, and with long hairs or vibrissæ. Large mucous glands abound in the lower part of the nose, and their apertures cover the surface.

In the upper part of the nose the mucous layer is less thick and vascular, and is of a yellowish colour. The epithelium is thick, especially over the olfactory region, and is laminar according to Bowman; though other observers state that it is ciliated at spots, and is columnar. The glands are numerous. In the olfactory region these resemble the sweat glands of the skin, and

open in rows between the nerve branches: their long ducts are lined by scaly epithelium.

Bloodvessels. As the *arteries* are not injected, suffice it to say that they are derived chiefly from the internal maxillary, and come through the spheno-palatine foramen. A few enter through the apertures in the roof from the ophthalmic artery; and near the nostril are branches of the facial. In the pituitary membrane they form a network; and on the surface and free edges of the two lower spongy bones they ramify in plexuses beneath the membrane.

The *veins* accompany the arteries, and form large venous plexuses on the septum nasi and the middle and lower spongy bones. Through the apertures in the cribriform plate of the ethmoid, the veins of the nasal cavity communicate with those in the cranium.

THE OLFACTORY REGION AND THE NASAL NERVES.

In the mucous membrane at the top of the nasal cavity the olfactory nerve ends, and the power of smelling resides. To this part the term olfactory region has been applied by Mr. Bowman. Its situation is under the cribriform plate of the ethmoid bone; and it extends down for about an inch on the septum nasi and the outer wall.

Over the limits of this region the mucous membrane is thin, as before said, with thick scaly epithelium, and the glands are like sweat-glands. The vessels construct a network in the adult; but in the fœtus Mr. Bowman found on injecting them loops here and there with enlargements, suggesting to him the idea of rudimentary papillæ.

Olfactory nerve.—The offsets of the olfactory nerve enter the nose through the foramina in the cribriform plate of the ethmoid bone; and penetrating the mucous membrane they divide and subdivide in a plexiform manner till they are reduced to the necessary degree of fineness; but the mode of ending of the nerve filaments is not known. Recent researches (Schultze) point to the ending of the branches in olfactory or nerve-cells, which resemble somewhat columnar epithelium, and project to the free

surface amongst the cells of the epithelium.* In their structure the nerve fibrils resemble the sympathetic more than other nerves, for they are granular, and are provided with oval corpuscles which become visible on the addition of acetic acid.

Upon this nerve the power of recognising odours depends. In ordinary breathing, when the air traverses chiefly the lower half of the nasal cavity, faint odours fail to give indication of their presence; but if the air is carried upwards into the olfactory region by sniffing, the odorous particles diffused in the air will be detected, because they are brought more completely into contact with the nerves. Touching the olfactory region with a solid body, as with a probe, does not excite the sensation of smell; but disease of the brain sometimes gives origin to supposed offensive odours.

Fifth nerve.—Through the following offsets of the first and second trunks of the fifth nerve, the pituitary membrane is supplied.

The nasal nerve of the ophthalmic trunk ramifies in the fore part of the cavity from the roof to the nostril; and acts as the guardian nerve of the anterior opening by endowing the part referred to with great sensibility. Irritation of the anterior portion of the nasal cavity gives rise through this nerve to the reflex act of sneezing, with the view of dislodging the unusual stimulus by a strong current of air rapidly expelled.

The spheno-palatine branches of the upper maxillary nerve furnish offsets through Meckel's ganglion to all the remainder of the cavity: these branches pass for the most part through the spheno-palatine foramen. Common sensibility, and the nutrition of the mucous membrane, are dependent upon this trunk of the fifth nerve.

* Manual of Human Microscopic Anatomy. By A. Kölliker. Lond. 1860, p. 604. In this work reference is given to the writings of Herr Schultze.

DESCRIPTION OF PLATE XXIX.

THIS Figure illustrates the dissection of the posterior part of the perinæum.

Boundaries of the perinæum.—The perinæal space corresponds with the outlet of the pelvis. It is limited in front by the symphysis pubis; behind by the tip of the coccyx with the great gluteal muscles; and on each side by the pubic arch and the great sacro-sciatic ligament.

Depth.—The perinæum reaches into the pelvis as far as the recto-vesical fascia, which forms the partition between the perinæum and the pelvic cavity (Plate xxxix.); and as this septal piece of fascia is directed obliquely downwards and inwards the measurements to it from the surface of the body will vary at different spots. In front near the pubes the depth of the space is about an inch, but behind it amounts to three inches by the side of the rectum.

Division into two.—In this region as above defined are contained in the male the excretory tubes for the feces and urine. A transverse line half an inch in front of the anus divides it into two, viz., a posterior or rectal, and an anterior or urethral part.

POSTERIOR PART OF THE PERINÆUM.

In the hinder part of the perinæum lies the rectum, but as the gut does not occupy all the space between the bones, there is a hollow on each side, the ischio-rectal fossa, which is filled with fat, and contains some vessels and nerves. On the left side the boundaries of the space may be defined; and on the right, the vessels and nerves may be brought into view, as in the Plate.

To begin the dissection raise the skin from the posterior part of the space by means of a transverse cut at the front of the anus, and of a longitudinal one carried backwards from the other, around

the anus, to the coccyx. In reflecting outwards the flaps of integument from the middle line the skin will be found to be very thin near the anus, and very adherent to the corrugator and sphincter muscles, so that without care the fleshy fibres will be removed with it. From the front and back of the sphincter a fleshy slip is to be followed on each side into the subcutaneous fatty layer.

Next remove the fat and the small vessels and nerves from the ischio-rectal fossa on the left side, regard being had only to the trunks of the pudic vessels and nerve on the outer boundary. And then trace through the fat in the right hollow the small vessels and nerves, as in the Plate.

Rectum. About the lower three inches of the large intestine is contained in the perinæum. This part of the gut rests on the end of the sacrum and on the coccyx. Whilst the rectum touches the bones it is straight in its direction; but at the end of the spinal column it is bent backwards, and ends at the surface in the anal aperture. It is not of uniform size, for at the anus it is narrowed much by the sphincter muscles, but an inch higher it is swollen into a sinus. This dilatation is enveloped by the levator ani muscle, C, on each side.

Commonly there are rounded swellings of a bluish colour projecting from the interior of the gut, which are denominated internal piles or hæmorrhoids; these are formed out of dilated veins in this manner. Within the internal sphincter the middle hæmorrhoidal arteries and veins form loops around the intestine under the mucous membrane, having an arrangement peculiar to this part of the alimentary passage.* From time to time parts of these loops become dilated; and in this state they form small tumours which are forced down together with the mucous membrane through the sphincter by the straining efforts to expel the contents of the rectum; and they carry with them some of the intermingled arterial loops. After a still longer interval the canal of the vein becomes obliterated by a solidified fibrinous clot, and

* The arrangement of these vessels and their disposition in hæmorrhoids have been delineated in a Work on Diseases of the Rectum, by Richard Quain, F.R.S. Lond. 1854.

the submucous areolar tissue outside becoming thickened, the whole forms a firm dense fleshy-looking mass. Of course the number and size of the piles will be proportioned to the enlargement of the veins, and the extent to which the loops have descended. If their removal is desired, some means, such as ligature, which would arrest the flow of blood, should be had recourse to; for as the veins are deprived of valves the swellings should not be cut off because the ends of the arterial and venous loops would remain open to bleed into the intestine.

Muscles of the rectum. Three muscles surround the lower end of the intestine, and are employed in diminishing its opening. A fourth elevates and constricts the gut.

A. Sphincter ani internus.
B. Sphincter ani externus.
C. Corrugator cutis ani.
D. Levator ani.
E. Gluteus maximus.

The *internal sphincter*, A, is a narrow band of pale circular fibres around the extremity of the rectum, which is continuous with the circular fibres of the gut. About a quarter of an inch in width at the surface, it is distinct from the external sphincter, B; and on the intestine it extends downwards half an inch, joining the muscular coat of that tube.

This muscle assists in closing the anus, and its action on that aperture is involuntary.

Corrugator cutis ani, C.—Superficial to the internal sphincter is a thin stratum of involuntary muscular fibres to which I have given the above name.* This subcutaneous layer extends around the anus, but only a part on the right side has been delineated. It begins rather external to the preceding sphincter; and the fibres converging enter the anus, and end in the submucous tissue inside the internal sphincter. It forms a thin layer around the anus, which is closely united to the skin.

When the fibres contract they corrugate the skin around the anus, throwing it into lines radiating from the aperture.

* This muscle was noticed by me in 1854. I have not found hitherto any reference to it in works of Anatomy. It is constantly present.

The *external sphincter*, B, surrounds the end of the rectum with a thin muscular layer about an inch in width, which is fixed in front and behind. The hinder part is attached by fibrous tissue to the back of the coccyx near the tip, and blends largely with the subcutaneous areolar tissue on each side: in the Figure this part, which is not always very evident, has been cut and reflected. In front, where the muscle is also wide, it is inserted into the central point of the perinæum, and on each side it joins the subcutaneous fatty layer by a rather wide slip.

This muscle shuts the anus and raises the skin around that opening. Through the close union of this muscle and the corrugator with the dermis, every alteration in the condition of their fibres is accompanied by movement of the skin; and so ulcers near the anus become very painful. Before rest can be obtained and the healing process established, the muscular fibres require oftentimes to be divided. Ordinarily the muscle is kept in a state of contraction through the influence of the spinal cord, and it is relaxed only at the time of passing the feces; but there exists also some voluntary power over the action of the muscle. When the spinal cord is injured the muscle passes from a tonic state to one of paralysis; and in long-continued exhaustive disease, as fever, it may become powerless, so as to allow of the feces escaping involuntarily.

The *levator ani*, D, forms with the muscle of the opposite side a fleshy diaphragm in the outlet of the pelvis. It is attached above to the inner surface of the os innominatum—partly to bone and partly to the recto-vesical fascia and the triangular ligament (Plate xxxviii.). The fibres descending are inserted into the tip of the coccyx; into the side of the rectum, blending with the sphincter; and before and behind the gut the muscles of opposite sides are joined. The fleshy stratum formed by the two muscles closes the outlet of the pelvis behind the triangular ligament, and is convex downwards: through it the rectum is transmitted. Its under surface looks to the ischio-rectal fossa, and the upper touches the recto-vesical fascia. The origin of the muscle is best seen in the Plate of the side view of the pelvis before referred to.

The chief action of the muscle is to raise and restore to its

place the lower end of the rectum after this has been protruded in defecation. It supports also the pelvic viscera, and compresses the tube of the urethra by its anterior fibres.

Ischio-rectal fossa. This hollow is so called from its position between the hip-bone and the rectum. Its extent on the surface of the body is marked by a line opposite the tip of the coccyx in one direction, and the fore part of the anus in the other. After dissection it appears as a somewhat conical interval, which is wide behind and narrow before, and decreases in breadth as it sinks into the pelvis. From before back it measures about two inches. Along the side of the pelvis its depth amounts to two inches. Across it is about an inch wide under the integuments.

Its outer boundary is vertical, and consists of the pelvis with the internal obturator muscle covered by fascia. The inner wall, very oblique, is formed by the levator ani, D, and the external sphincter, B; this surface is covered by a thin fascia. In front is the triangular ligament of the perinæum. Behind lies the gluteus maximus, E; and deeper still is the sacro-sciatic ligament.

Vessels and nerves pass through the space. On the outer wall lies the internal pudic artery, *a:* it is contained in a sheath of fascia, which keeps it in place; and it is accompanied by two veins and the pudic nerve. Posteriorly the vessel is placed about one inch and a-half from the surface of the pubic arch, but towards the front of the fossa only half an inch from the edge of the bone. Crossing the space (left side) from the pudic trunks are the inferior hæmorrhoidal vessels, *b*, and the inferior hæmorrhoidal nerve, 3, which distribute branches to the lower end of the gut. At the front of the hollow, close to the outer wall, lie the two superficial perinæal nerves, 1 and 2, with the superficial perinæal artery sometimes: these pass forwards to the anterior half of the perinæum. Behind, near the coccyx, another small nerve, 5, may be recognised: this is an offset from the fourth sacral to the extremity of the rectum, and the teguments. Winding round the border of the gluteus maximus at the back of the space, are superficial branches of the sciatic vessels and nerve.

A granular fat fills the hollow and supports the gut. Its deficiency in emaciated bodies causes a surface-depression on the side

of the anus. Abscesses are prone to form in it, which manifest a striking tendency to leave sinuses or fistulæ behind them. The different conditions of these sinuses have received special names. If a sinus opens into the lower part of the gut as well as on the skin, having thus an inner and an outer orifice, it is said to be a complete fistula. Supposing the abscess to discharge its contents on the surface of the body in the usual way, the sinus remaining is named an incomplete external fistula; and if it bursts into the gut through the inner boundary of the ischio-rectal fossa without opening externally, the passage remaining is called a blind internal fistula. When abscesses enter the gut they pierce the levator ani and the intestinal wall, and usually at a spot about an inch from the anus. These burrowing passages need to be laid open before they will heal, like sinuses in the groin; and in slitting with a knife those that pierce the gut, the levator ani, the external sphincter, and the intestine, will have to be divided.*

Bloodvessels of the posterior part of the perinæum. The small arteries and veins supplying the lower end of the rectum, are derived from the pudic. Some others are distributed in the integuments by the sciatic vessels.

a. Pudic artery.
b. Inferior hæmorrhoidal.
c. A second hæmorrhoidal branch.
d. Branches of the sciatic.

The *pudic artery*, *a*, an offset of the internal iliac in the pelvis, enters the perinæum through the small sacro-sciatic notch, and ascends through this region to end in the penis or the clitoris, according to the sex. In the hinder part of its course the vessel lies in the ischio-rectal fossa, and gradually becomes more superficial in front, as before said. It is accompanied by two veins, by the trunk of the pudic nerve which is deeper than it, and by the the perinæal branch of the same nerve which is nearer the surface.

* Mr. Marshall has proposed that these sinuses should be cauterized by a wire heated by galvanism, with the view of preventing secondary hæmorrhage. See a paper in Vol. xxxiv of the Transactions of the Roy. Med. Chir. Society.

The anterior part of the vessel appears in Plate xxxi. In this part of its course it gives the following branch to the rectum.

The *inferior hæmorrhoidal* artery, *b*, crosses the centre of the ischio-rectal fossa, and divides near the gut into branches for the supply of the muscles, the integuments, and the fat. One or two of its offsets run forwards to the teguments in front of the ischio-rectal fossa. The artery may be represented by two pieces, as in the Plate.

Pudic veins. Two veins accompany the pudic artery, and they receive from the ischio-rectal fossa small veins, which are companion branches of the hæmorrhoidal artery.

Sciatic artery. Branches, *d*, of this artery come to the surface round the gluteus: most of them end in the integuments, but some enter the muscular fibres. Veins run with the arteries.

Nerves in the posterior part of the perinæum. Nerves from three sources, viz., sacral, pudic, and small sciatic, are met with in the ischio-rectal fossa.

1. Anterior superficial perinæal.
2. Posterior superficial perinæal.
3. Inferior hæmorrhoidal.
4. Branches of the small sciatic.
5. Branch of the fourth sacral.
6. Branches of the lower sacral nerves.

The *pudic nerve* is a branch of the sacral plexus, and accompanies the artery of the same name, distributing offsets like it for the most part. In the posterior half of the perinæum the nerve lies deeper than the artery (Plate xxxi.), and furnishes the two following branches :—

The *inferior hæmorrhoidal*, 3, runs with the artery of the same name across the ischio-rectal fossa, and ends in the external sphincter muscle and the integuments. Some offsets are directed forwards to the fore part of the perinæum.

The *perinæal branch* of the pudic, of larger size than the piece of the trunk continued to the penis, furnishes all the remaining nerves of the perinæum. It begins about half way along the fossa, and becoming superficial to the artery splits into cutaneous, muscular, and genital offsets :—

Only the two cutaneous offsets are now dissected in part: th are named superficial perinæal, anterior, 1, and posterior, 2, a are contained for a short space in the ischio-rectal fossa, as th course forwards to end in the scrotum.

Sacral nerves. A branch of the fourth sacral nerve, 5, pierc the fibres of the levator ani near the tip of the coccyx, and distributed to the external sphincter and the integuments.

Altogether behind the ischio-rectal fossa one or two other sm branches of the sacral nerves will appear (according to t extent of the dissection) by the side of the coccyx: they pier the fibres of the gluteus maximus, and ramify in the integumen

Small sciatic nerve. Cutaneous branches, 4, of this nerve wi round the gluteus muscle to reach the integuments near t sacrum and coccyx.

In the posterior half of the perinæum the first incisions in t lateral operation of lithotomy are begun. With the view opening a way down to the urethra, and of securing an apertu in the integuments large enough for the free use of the force and the extraction of the stone, the operator sinks his kni through the skin just in front of the anus, and carries it dow wards and backwards as far as midway between the anus and t ischial tuberosity. In this first stage of the operation the kni should be kept in the middle of the ischio-rectal fossa, and shou be made to penetrate more deeply behind than in front. Nece sarily the hæmorrhoidal vessels and nerves crossing the fos must be cut as the hollow is laid open. If the incision in t skin is too near the anus the rectum may be cut, and if it taken close to the bone externally the pudic artery may injured. In the usual adult state of the parts the pudic vess cannot well be reached, but in a child in whom the bones a undeveloped, or in a man with a very narrow pelvic outlet, t artery might be wounded at the fore part of the fossa, where becomes much more superficial. The rectum will usually rema untouched in the living body, supposing it to have been pr viously freed from its contents, by pressing it inwards away fro the scalpel with the fore finger of the left hand.

Within a distance of three inches from the anus the gut may be cut, where disease renders an operation necessary, without fear of passing the limits of the perinæum, and entering the cavity of the pelvis. Should the lower end of the rectum be removed the sphincters and levator ani would be destroyed, and an inability to control the passing of the feces would necessarily follow such an operation.

DESCRIPTION OF PLATE XXX.

THE superficial fascia, muscles, vessels, and nerves of the anterior half of the perinæum, are delineated in this Figure.

Supposing this dissection follows that in Plate xxix., it may be executed by raising laterally the skin by means of a central longitudinal incision from the scrotum to a transverse cut in front of the anus. For the reflection of the subcutaneous fatty layer air should be blown beneath it, on each side, by means of a blow-pipe inserted through it at the fore part of the ischio-rectal fossa; and then an incision should be made through the fat along the track of the air.

On the left side throw outwards the fatty layer to show its hinder and lateral attachments, and a membraniform layer on the under surface; but the part extending on to the thigh may be removed down to the fascia lata, as in the Drawing. On the right side the superficial perinæal vessels and nerves are to be traced out as the superficial fascia is reflected.

When the fatty layer has been examined it may be partly removed on both sides for the display of the muscles.

ANTERIOR PART OF THE PERINÆUM.

This part of the perinæal space is placed anterior to a line half an inch in front of the anus. It lodges the tube of the urethra,

and the roots of the penis with their appertaining muscles, vessels, and nerves. Commonly its form is an equilateral triangle, and its sides measure three inches. Its boundaries have been detailed (p. 241). All the parts included in this space are covered by the subcutaneous fatty layer described below.

The *superficial fascia*, G, clothes the body under the skin, and is directly continuous with the same layer in the scrotum and on the thighs; but as it is continued into the scrotum it loses its fat, and acquires involuntary muscular fibres, forming therewith a contractile tissue (dartos).

Over the fore part of the perinæal space the fascia possesses a membranous layer on the under surface, which is indicated in the Plate, and has the following connections:—Externally it is fixed into the margin of the hip-bone outside the crus penis. Behind, it bends down at the back of the transversalis muscle, to be united with the triangular ligament of the urethra. And in front it is continued into the scrotum without being connected with any subjacent part. Attached thus on the sides and behind, it arches over the space containing the urethral tube and the muscles. From its under surface some areolar tissue projects downwards opposite the urethra, and forms a partition between the right and the left side: this is a complete septum behind, but is incomplete in the scrotum where it is pervious to air or fluid.

The space thus included by the attachments of the superficial fascia opens into the scrotum in front, and is partly subdivided behind. When air is blown under the fascia it passes forwards on the same side as far as the median septum is complete, and it then diffuses itself in the scrotum; but if more air is still forced in on the same side it will move backwards from the scrotum along the opposite side of the perinæum. When urine finds its way into the fore part of the perinæum through an aperture in the urethra it is directed forwards through the scrotum, like the air, by the attachments of the superficial fascia on the sides and behind.

Tube of the urethra. In the side view of the male pelvis (Plate XL.) this tube may be seen to extend from the bladder to the end of the penis. In its course it passes through the

triangular ligament of the urethra, and is divided by that structure into three parts: a posterior or prostatic, an anterior or spongy, and a middle or membranous which is contained in the ligament.

The spongy portion, which occupies the anterior half of the perinæal space, lies in the midline of the body, and gives rise to a prominence under the central ridge or raphé of the skin. Altogether behind it is placed an inch from the pubes and from each hip-bone; and after an extent of two inches it is applied to the under part of the penis. For a distance of two inches about it is covered by a voluntary muscle.

Muscles of the urethra and penis. In the fore part of the perinæum there are superficial and deep muscles. The superficial layer is represented in this Plate, and consists of three on each side: two of these, C and D, are connected with the tube of the urethra, and one, F, belongs to the penis. Between the urethra and the penis is a tendinous point—central point of the perinæum, in which the muscles blend.

A. Sphincter ani externus.
B. Levator ani.
C. Transversalis perinæi.
D. Ejaculator urinæ.
E. Gluteus maximus.
F. Erector penis.

The *central point of the perinæum* shows best in Plate xxxi. It is a firm white spot, lying nearly in the centre of the pelvic outlet, which serves as a fixed point for the attachment of the urethral and rectal muscles. On the surface of the body it corresponds with a point half an inch in front of the anus.

The *transversalis perinæi* muscle C, lies obliquely across the perinæum, about half an inch in front of the anus. It arises from the inner surface of the hip-bone in front of the ischial tuberosity: and its fibres are directed obliquely forwards to the central point of the perinæum, where it joins the muscle of the opposite side and the external sphincter. When the muscle is largely developed it unites with the accelerator urinæ by a considerable slip (transversalis alter). Behind this muscle the superficial fascia bends down to the triangular ligament; and when the

fascia is removed the muscle hangs lower, as on the right side in the Plate.

This muscle when acting with its fellow fixes and draws upwards and backwards the central point of the perinæum: the two may compress in like manner the bulb of the urethra beneath.

The *ejaculator urinæ*, D, covers the urethra, and consists of two halves, right and left, which are united by a tendon in the middle line. The fibres of each half arise from the median tendon and from the central point; and they are directed outwards over the urethra to be inserted by three slips in the following manner:— The anterior fasciculus, formed by the longest fibres, takes its attachment to the outer part of the penis; the posterior is inserted into the subjacent triangular ligament; and the middle or intermediate turns round the urethra, and unites with the corresponding slip of the other side. The muscle covers the spongy part of the urethra for about two inches in front of the triangular ligament; and the manner in which the tube is surrounded will appear when the ejaculator is detached in a deeper dissection.

By surrounding the urethra the muscle acts as a sphincter on the water passage, and can expel with force the fluid from that tube. During the continuous flow of the urine the fibres of both sides are relaxed; but at the time of the expulsion of the last of the stream they come into forcible contraction under the influence of the will. In the expulsion of the semen the action of the muscle is involuntary.

Erector penis, F. This muscle conceals the crus penis. It is attached to the innominate bone on each side of, and behind the crus; and it is inserted anteriorly by aponeurotic fibres into the inner and outer surfaces of the crus, where this joins the body of the penis.

It compresses the crus penis on which it lies, and retards the escape of blood from that body through the veins: in this way it assists in the distension of the penis.

A triangular interval exists between the three muscles above described. It is bounded externally by the erector penis, F, internally by the ejaculator urinæ, D, and posteriorly by the transversalis perinæi, C. In the area of this space the triangular

ligament appears; and the superficial perinæal vessels and nerves course forwards through it. In the first stage of the lateral operation for stone, when the operator is making the way down to the urethra, the knife may be brought into the hinder part of the space, and may cut through the transverse muscle, part of the ejaculator, and some of the superficial perinæal vessels and nerves. This is likely to happen if the cutaneous incisions are begun too far forwards; but if the operation is well planned and executed, the scalpel will be sunk behind the transversalis muscle, and through the levator ani at the fore and inner part of the ischio-rectal fossa.

Superficial perinæal vessels. The arteries which are distributed to the superficial muscles and the integuments are derived from the pudic trunk. Veins accompany the arteries, and end in the pudic.

a. Superficial perinæal artery.
b. Transverse perinæal artery.
c. Cutaneous offsets of the superficial perinæal to the thigh.

The *superficial perinæal* artery, *a*, arises from the pudic trunk near the front of the ischio-rectal fossa, and crosses over the transversalis muscle as it courses forwards to end in the scrotum; at the fore part of the perinæum it divides into pieces, and it is sometimes split into two from the origin. It furnishes offsets to the superficial muscles, to the integuments of the thigh, and sometimes the following.

The *transverse perinæal* artery, *b*, comes either from the preceding or from the pudic trunk near it, and passes inwards behind the transversalis to end in the integuments, and in the muscles between the rectum and the urethra.

The *veins* with the superficial perinæal artery are large and plexiform at the scrotum.

Superficial perinæal nerves. Three nerves supply the integuments and the muscles, and these are offsets of the pudic and small sciatic.

1. Inferior hæmorrhoidal nerve.
2. Posterior of the two superficial perinæal.
3. Anterior of the two superficial perinæal.
4. Inferior pudendal nerve.

Two *superficial perinæal* nerves come from the large perinæal branch of the pudic in the ischio-rectal fossa (p. 247) and run forwards with the vessels to the scrotum, in which they ramify. At the scrotum they unite together, as well as with the inferior pudendal.

The more posterior branch, 2, which is likewise the most superficial, ends chiefly in the integuments. The anterior nerve, 3, passes generally under the transversalis muscle, and supplies the levator ani and the other superficial muscles as it is directed forwards to the scrotum.

The *inferior pudendal* nerve, 4, is a branch of the small sciatic, and pierces the fascia lata of the thigh near the border of the gluteus maximus. Thence being directed forwards, it pierces the superficial fascia, and accompanies the other nerves to the scrotum. Soon after it appears it is joined by the inferior hæmorrhoidal; and nearer the scrotum, by the superficial perinæal.

From the superficial position of the spongy part of the urethra, a catheter or sound passing along it can be felt readily throughout; and in a case of difficulty in moving the instrument along, assistance may be given with the finger of the other hand.

Stricture of the urethra is most frequent where the tube is covered by the ejaculator urinæ muscle. In the operation of cutting down upon the stricture, from without, the muscle and the spongy wall of the urethra will have to be divided, but little danger of bleeding will be run if the incision lies directly in the middle line, for no vessel of any size will be met with there; and if the knife is passed through the median tendinous line between the ejaculator muscles, the only structure to furnish blood will be the spongy vascular wall of the urethra.

If openings in the tube of the urethra should occur in consequence of disease or accident the urine may escape from the passage, and become diffused beneath the superficial fascia of the perinæum. After the fluid is extravasated it will be directed forwards to the scrotum, as before said, by reason of the insertion of the superficial fascia into the firm underlying parts (p. 250).

DESCRIPTION OF PLATE XXXI.

THIS Figure is designed to exhibit the triangular ligament of the urethra, and the muscles and vessels enclosed in it.

This third dissection of the perinæum may be made, after the preceding, by taking the ejaculator urinæ from the urethra, and by detaching on the left side the erector penis and the crus penis from the bone. Next a vertical cut on the left side may be carried through the fore part of the triangular ligament, for the lower two thirds of the depth, to show the parts between the layers.

THE URETHRA AND THE TRIANGULAR LIGAMENT.

The tube for the conveyance of the urine curves through the fore part of the perinæal space from the bladder to the end of the penis, and pierces the triangular ligament. It is divided into three regional parts, as before said (p. 250). In Plate XL. the form and length of these divisions are better displayed.

The spongy or outer portion, about six inches in length, receives its name from being surrounded by a vascular structure, the corpus spongiosum urethræ. Posteriorly the spongy material swells out into the bulb, C, where the diameter of the canal is also enlarged; and in front it is dilated into the glans penis, with a corresponding dilatation inside. Usually there is a median depression in the bulb, over the position of a partition which divides the corpus spongiosum into a right and a left half. The swelling of the bulb is united to the front of the triangular ligament by fibrous tissue; and it, with two inches of the urethra, is covered by the voluntary ejaculator urinæ muscle.

The membranous part of the tube, the shortest, is directed upwards and backwards through the layers of the triangular ligament. Its length is rather less than an inch. Its distance from

the symphysis pubis is about an inch, and it lies about equidistant between the hip-bones. Within the layers of the triangular ligament it is surrounded, like the spongy part, with a voluntary muscle, the constrictor urethræ, H.

The prostatic or the innermost portion of the urethra is about one inch and a quarter in length. It is contained altogether in the prostate; and it will have the same connections with surrounding parts as that body.

The *triangular ligament*, K, acts as a suspensory band to the urethra, and fills the fore part of the pubic arch: it closes also the interval between the contiguous borders of the levatores ani. Its widest part is turned backwards; and its length from above down is about one inch and a-half.

It is connected with the parts around in the following way:—The apex is united with the symphysis pubis. The base, somewhat arched on each side, joins in the middle line the central point of the perinæum, whilst laterally it is connected with the superficial fascia and a fascia covering the levator ani in the ischio-rectal fossa. On each side the ligament is fixed into the hip-bone.

Two membranous strata enter into the composition of the triangular ligament. Named anterior and posterior, these are near together above, but are widely separated below by the urethra and its muscles. Only the anterior layer is visible in this Plate.

The anterior layer, partly cut through on the left side, is a thin fibrous membrane, which permits the subjacent muscular fibres and the vessels to be seen through it. It has several apertures:—Thus perforating the ligament in the middle line, one inch from the pubes and the sides of the pubic arch, is the tube of the urethra; and midway between the former opening and the pubes the dorsal vein of the penis pierces both layers of the ligament. On each side, near the apex, the dorsal artery and nerve of the penis issue through separate holes in the anterior layer.

The posterior layer of the ligament is continuous with the pelvic fascia; and it may be seen in Plate xxxix. of the pelvis.

Between the layers of the ligament on each side the following

parts are inclosed. Near the base of the ligament, and directed transversely towards the urethra, are the deep transverse muscle, J, and the constrictor urethræ, H; and under these, near the middle line and below the tube of the urethra, lies Cowper's gland. Along the side of the ligament, where it is fixed to the bone, the pudic artery is situate: this sends inwards near the base of the ligament a transverse branch to the bulb. And by the side of the artery, but deeper than it, and contained in a separate tube of fascia, is the pudic nerve.

MUSCLES OF THE MEMBRANOUS PART OF THE URETHRA.

Between the layers of the triangular ligament two muscles are included, viz. deep transverse, and the constrictor urethræ. The other muscles in the Drawing have been already noticed in the description of the two foregoing Plates.

A. Sphincter ani externus.
B. Levator ani.
C. Bulb of the urethra.
D. Ejaculator urinæ, cut.
E. Gluteus maximus.
F. Erector penis.
G. Crus penis, cut.
H. Constrictor urethræ.
J. Deep transverse muscle.
K. Triangular ligament of the urethra.

The *deep transverse* muscle, J, is a narrow fleshy slip which lies along the base of the triangular ligament, nearly beneath the superficial transverse muscle. Externally it arises from the pubic arch; and internally it joins below the urethra the muscle of the opposite side, and is fixed into the central point of the perinæum. This muscle is not always separate from the following.

The muscle acts like the superficial transverse in fixing the central point of the perinæum, and drawing backwards the urethral tube.

Constrictor urethræ, H. This muscle extends transversely from the pubic arch to the urethra, and unites on that tube with its fellow. The two muscles taken together resemble the sphincter ani externus placed transversely.

It has a tendinous origin from the pubic arch and from the posterior layer of the triangular ligament, and it divides near the

urethra into two fleshy strata which pass, one over, and the other under that tube, to join similar parts of the muscle of the opposite side. These fleshy strata reach the whole length of the membranous part of the urethra, surrounding it, and end in a median tendon (more or less complete) both above and below the passage.

When the muscles of both sides act the urethral canal will be diminished like the end of the rectum by the external sphincter. During the act of making water the muscles are relaxed; but they act spasmodically, like the ejaculatores urinæ, in expelling the last portion of that fluid, or the semen. The muscle resembles the ejaculator urinæ in acting only with its fellow.

*Orbicularis urethræ.**—Encircling the urethral tube within the fibres of the constrictor is a thin layer of circular involuntary muscular fibres, which is continuous behind with the fibres of the prostate.

PUDIC VESSELS.

The trunks of the pudic artery and nerve are delineated on the left side; and the distribution of the deep muscular branches is shown on the other.

a. Pudic artery in the ischio-rectal fossa.
b. Pudic artery in the triangular ligament.
c. Dorsal artery of the penis.
d. Superficial perinæal, cut.
e. Deep transverse perinæal branch.
f. Branch to corpus spongiosum urethræ.
n. Artery of the bulb.

The *pudic artery*, *a*, courses along the os innominatum, and lies partly in the ischio-rectal fossa, and partly in the triangular ligament. The artery, *b*, between the layers of the ligament is more or less covered by the fibres of the constrictor urethræ, and gives a considerable branch to the bulb of the urethra. Near the pubes it perforates the fore part of the ligament, and becomes the dorsal artery of the penis, *c*.

As soon as the artery appears through the ligament it furnishes a small branch (art. corporis cavernosi) to the crus penis: this has not any letter of reference.

* I have so designated this muscle from its arrangement and action, and have described it in the xxxix. Vol. of the Roy. Med. Chir. Trans. for 1856, p. 327.

The *branch to the bulb*, *n*, is seen to run transversely through the fibres of the constrictor, and about half an inch from the base of the ligament, to be distributed in the corpus spongiosum urethræ: it supplies an offset to Cowper's gland. Most commonly it is placed in part superficial to the constrictor muscle.

If this branch springs from the pudic trunk below the level of the ligament it will cross the front of the ischio-rectal fossa to reach its destination, and will be liable to injury in the lateral operation for stone.

Deep muscular branches. These arise by a common offset from the pudic trunk, or from the superficial perinæal artery; they are indicated on the left side.

A deep transverse perinæal branch, *e*, which is sometimes united with the superficial transverse, ends in the fore part of the sphincter and the levator ani. From it an offset is directed through the base of the triangular ligament to supply the constrictor urethræ and the corpus spongiosum urethræ.

Pudic veins. Two veins course with the pudic artery along the side of the perinæal region, and they are joined by veins which accompany the branches of the artery. The companion vein of the dorsal artery of the penis does not join the pudic veins, but enters the pelvis through the triangular ligament, and ends in the vesico-prostatic plexus.

PUDIC NERVE AND ITS DEEP BRANCHES.

The pudic nerve lies in part in the ischio-rectal fossa, and in part in the triangular ligament; and finally perforating the fore layer of the ligament, like the artery, becomes the dorsal nerve of the penis.

In the ischio-rectal fossa the nerve is deeper than the artery: here it furnishes a large perinæal branch, which passes forwards on the opposite side of the pudic artery, and splits into the two superficial perinæal nerves before described (p. 253).

Between the layers of the triangular ligament the nerve remains still deeper than the pudic vessels, and lies in a separate sheath of fascia. No offsets are supplied from this last part of the nerve.

The *deep branches* come from the deeper of the two superficial

perinæal nerves:—One, 4, pierces the triangular ligament, and ends in the constrictor urethræ muscle, H; this same branch supplied in this body the erector penis, F. Another branch, 5, enters the corpus spongiosum urethræ.

The most direct and the shortest course into the bladder from the perinæum is through the central point, which is marked thus *; and through it the membranous part of the urethra is entered in both the median, and the bilateral operation for stone.

In the lateral operation for stone the surgeon enters the knife obliquely into the membranous part of the urethra.

In the first stage of the operation the incisions down to the urethra are carried by the side of the rectum and through the ischio-rectal fossa, as before related (p. 248), instead of through the central point of the perinæum.

The second stage consists in opening the membranous portion of the urethra; and the Drawing shows what parts would be cut through, as the knife is placed in the staff. Thus the base of the ligament, the deep transversalis, and the constrictor urethræ muscle, and the deep nerves and vessels (seen on the right side) would be in part divided. The artery of the bulb ought not to be cut, and unless the first incisions are begun too far forwards it will not be injured, when it has its ordinary arrangement; but when it arises behind the triangular ligament, and crosses the fore part of the ischio-rectal fossa to reach the bulb, it lies immediately before the scalpel, and cannot be avoided by care and knowledge on the part of the surgeon.

In the third stage of the operation the knife is carried through the membranous and prostatic parts of the urethra into the bladder: the direction of the incision and the parts to be cut through and avoided will be best understood when the side view of the pelvis is referred to (Plate XL.).

In retention of urine from stricture at the back of the spongy portion of the urethra, the distended membranous part projects towards the surface at the middle of the triangular ligament, near the base, and can be readily reached through the central point of the perinæum.

DESCRIPTION OF PLATE XXXII.

A SURFACE view of the lower part of the tendon of the external oblique muscle, with the superficial fascia, vessels, and nerves of the groin.

The skin being reflected from the groin by a triangular flap, as indicated in the Drawing, the fatty layer containing the vessels comes into sight; and this with its vessels may be thrown towards the thigh, like the skin, after it has been examined. Underneath it appears a thin fibrous layer, H, which may be detached from the aponeurosis of the subjacent muscle as far as the thigh. The tendon of the oblique muscle may then be cleaned with little trouble.

SUPERFICIAL STRATA, VESSELS, AND GLANDS.

Between the skin in the groin and the subjacent muscles two superficial layers are interposed. One is in contact with the cutis, and contains the fat; the other, thin and membranous, rests on the tendon of the external oblique muscle.

The more subcutaneous fatty layer, called the superficial fascia, varies in thickness here as elsewhere with the obesity of the body. In it ramify superficial vessels from the femoral artery with veins; and as the stratum is separated from the subjacent one by a line of glands at the top of the thigh, it can be easily raised and thrown downwards, as in the Figure.

The deeper stratum, H, thin and translucent, is destitute of fat, and is known as the aponeurosis of the fascia lata (Scarpa), or the deep layer of the superficial fascia. Distinct from the subcutaneous layer at the top of the thigh, glands and vessels intervening, it becomes thinner and less separate as it ascends on the abdomen. When followed down to the limb it will be found to blend with the fascia lata, G, a little below the tendon of the external oblique muscle.

Cutaneous vessels.—In the fatty layer are contained the following small arteries and veins.

a. Superficial epigastric artery.
b. Superficial pudic artery.
c. Superficial circumflex iliac artery.
d. Superficial pudic vein.
e, *f*. Superficial epigastric veins.

The three small *arteries* above mentioned ramify in the fat: they are the first branches of the femoral trunk, and communicate with offsets of deeper arteries of the same name. As their names express, the pudic branch, *b*, ends in the pubes and the integuments of the penis; the epigastric, *a*, in the teguments of the lower part of the belly; and the circumflex iliac, *c*, in the fat of the outer portion of the thigh.—Many variations occur in their arrangement: in this body the epigastric was divided into branches, and the circumflex iliac was small.

As the superficial pudic crosses the cord it may be cut when the integuments are divided in the operation for inguinal hernia. Usually the vessel is so small as to be disregarded, because the hæmorrhage soon ceases after its section; but if the bleeding is troublesome a ligature ought to be placed on the end nearest the femoral trunk.

Veins. Superficial veins of the same name run with the arteries, and have a like extent. Single or double as they lie with the arteries, they converge below to the internal saphenous vein into which they open.

Inguinal glands.†† Along the line of Poupart's ligament lies a chain of superficial inguinal lymphatic glands, which are marked as above.—They are situate between the subcutaneous fatty layer and the thin aponeurosis of the fascia lata, H, and receive lymphatics from the contiguous parts of the abdomen and outside of the pelvis, and from the genital organs; and they communicate by deeper lymphatics with glands by the side of the large blood-vessels.—Usually they are about three or four in number, but this varies with their size.

Irritation of the lymphatics entering the glands, especially of those of the penis and urethra, occasions slow suppuration with sluggish abscesses. Callous indurated sinuses remain after

the pus has been discharged, and the healing process is further retarded by the constant movements of the limb. Most commonly the sinuses have to be laid open before they can be made to heal.

FIRST MUSCULAR LAYER.

The outer muscle of the groin is the external oblique, which receives its name from the direction of the fibres, and the situation in the abdominal wall. Fleshy on the sides, it is tendinous or aponeurotic on the front and below; and near the middle line the aponeurosis blends with the tendon of the muscle beneath.

A. Aponeurosis of the external oblique muscle.
B. External pillar of the abdominal ring.
C. Internal pillar of the abdominal ring.
D. Poupart's ligament.
E. Spermatic cord.
F. Intercolumnar fibres.
G. Fascia lata.
H. Aponeurosis of the fascia lata.
I. Linea alba.
J. Linea semilunaris.
K. Iliac crest of the hip bone.
†† Inguinal glands.

The part of the aponeurosis which has been laid bare, has the following attachments. Along the middle line it unites with its fellow in the linea alba, I, reaching to the front of the os pubis. Below it is fixed at the outer part to the iliac crest, K, and at the inner part to the spine and pectineal line of the pubes by the slip, B; and between those two bony attachments it forms the strong rather rounded band of Poupart's ligament, D, across the thigh.

The aponeurosis is constructed of separate threads directed downwards and inwards obliquely. Near the top of the thigh its fibres are thicker than elsewhere; and a little above and external to the pubes they are separated for a short space, so as to leave an interval—the external abdominal ring. For the purpose of binding together the longitudinal fibres and giving strength to the aponeurosis, a stratum of oblique fibres (intercolumnar) is continued over the surface. Here and there are small apertures in the aponeurosis for the transmission of superficial vessels and nerves.

The named parts of the aponeurosis visible in the Drawing are, the linea alba, linea semilunaris, Poupart's ligament, and the external abdominal ring.

The *linea alba*, I, is a strong tendinous band along the midline

of the belly, which reaches from the pelvis to the chest, and in which the aponeuroses of the flat muscles of opposite sides are blended.

Linea semilunaris, J. This is a yellowish line, somewhat depressed even before the integuments are removed, which is directed upwards from the tuberosity of the pubes to the tip of the eighth rib. It marks the position of the outer edge of the rectus muscle, and is rather less strong below.

Poupart's ligament, D, is the thickened lower edge of the aponeurosis across the top of the thigh. Externally it is rounded, and is attached to the front of the iliac crest; internally it becomes widened, and is fixed into the spine and the pectineal line of the hip-bone; and below it blends with the fascia lata, G. This band is curved downwards towards the thigh so as to make the outer third oblique, and the two inner thirds more horizontal in direction. Like the linea alba, it serves as a fixed point for the underlying muscles and the surrounding fascia. It receives also the name crural arch; and in Plate xxxvi. the reason of this name appears, as the aponeurosis is shown arching over muscles, vessels, and nerves at the top of the thigh.

This firm band can be felt readily through the integument, and marks the limit between the abdomen and the thigh. Even the nature of a hernial tumour may be decided by its position to the band; for if the swelling lies above the ligament it forms an inguinal hernia, and if it projects to the surface below, it constitutes a femoral hernia.

The *external abdominal ring* or the opening in the aponeurosis of the oblique muscle, transmits the testicle in the fetus. Triangular in form, with the apex upwards and outwards, it is placed outside the pubes and extends considerably above that point of bone.—It measures commonly about one inch from base to apex, and half an inch across; but it varies much in size in different bodies, and is smaller in the female than the male. The pieces of the aponeurosis bounding it laterally are named the pillars. The inner pillar, C, flat and thin, is continued to the front of the pubes; and the outer, B, curved around the spermatic cord which rests on it, is fixed to the spine of the pubes, and joins Poupart's

ligament below. In this opening lies the cord in the male, and the round or suspensory ligament of the uterus in the female; and through it the inguinal hernia is protruded.

From its margin a thin fascia is prolonged on the spermatic cord or the round ligament, which is called intercolumnar from its position; and when this covers a hernia it is named the spermatic fascia. In a large hernia this stratum becomes much thickened.

Variations in the size of the opening will affect differently a hernia protruding through it. If the aperture is small its sharp edges will offer some resistance to the return of the gut, and may even constrict the intestinal vessels; whilst if it is larger than usual no impediment will arise from its then comparatively lax margins. After a hernia has existed for a time the opening assumes a rounded form, and from this circumstance the term "ring" has been derived.

The sharpness of the edges and the capacity of the external abdominal ring are modified by the position of the limb to the trunk. When the limb is extended, as in standing, Poupart's ligament is drawn down by the tightened fascia lata of the thigh, and the margins of the opening are rendered tense, whilst the interval between them is diminished. But when the limb is placed in the opposite state, viz., raised and rotated in, Poupart's ligament rises, becoming lax, and the sides of the ring being loose, greater capacity can be more readily imparted to it. In an attempt therefore to push back a hernia the manipulator should see that the hip-joint is bent and rotated in, whilst the person is in a recumbent posture, in order that no impediment shall arise from unrelaxed fasciæ or tendons.

Over this opening the pad of a truss has to be placed in internal or direct hernia; and its position on the surface of the body can be ascertained in this way:—Carry the fore finger along the ridge of the pubic crest from within out, and as soon as it passes the limit of that bony ridge it will be placed over the external abdominal ring.

The *intercolumnar fibres*, F, form a continuous covering upon the aponeurosis of the external oblique. Near the apex of the

abdominal ring they are stronger than elsewhere, and to the thickened bundle in that situation the name "intercolumnar" is given. In this band the fibres form arches with the concavity up, and are prolonged downwards and outwards to Poupart's ligament. By their transverse position they unite together the diverging slender threads of the aponeurosis of the oblique; and passing the pillars of the abdominal ring they give strength to that part so weakened by the existence of a large hole.

The *spermatic cord*, E, reaches from the testicle to the cavity of the abdomen and passes obliquely through the groin (Plate xxxiv.). It consists of the vessels, nerves, lymphatics, and excretory duct of the testicle, which are surrounded by coverings derived from the abdominal wall and the scrotum. As it lies in the external abdominal ring it rests upon the outer pillar, and receives the thin intercolumnar covering from the margin of that opening. A hernia escaping through the external ring will be superficial to the cord, and will descend within the covering derived from the margin.

Cutaneous vessels. Several small arteries with companion veins issue through apertures in the aponeurosis of the external oblique: these are distinct from the cutaneous vessels of the groin before described (p. 262), which belong to the femoral trunks.

Five small arteries appear near the middle line, and are derived from the epigastric in the abdominal wall: another is placed near the iliac crest of the hip-bone, and comes from the circumflex iliac artery.—A branch, larger than the rest, though like them unnamed, issues through the abdominal ring with the cord, and ends in the integuments of the scrotum and upper and inner parts of the thigh. Cutaneous nerves accompany most of the arteries.

Cutaneous nerves. The nerves are more constant than the vessels in their position and distribution, and some of them are named: they perforate the aponeurosis of the external oblique.

1. Cutaneous part of the ilio-inguinal.
2. Ending of the ilio-hypogastric.
3. Cutaneous endings of the dorsal nerves.

The *ilio-inguinal* nerve, 1, is a branch of the lumbar plexus. It courses through the parietes of the abdomen as far as the external abdominal ring, through which it issues to supply the integuments of the scrotum or of the labium, and of the contiguous part of the thigh, like its companion artery.

The *ilio-hypogastric* nerve, 2, arises with the preceding from the lumbar plexus, and passing with it through the wall of the abdomen, ends near the pubes in the integuments of the hypogastric region: further back it gives a cutaneous iliac branch over the crest of the hip bone.

Dorsal nerves. The lower six of these nerves are partly contained in the wall of the abdomen: they perforate the external oblique tendon, like the two preceding, and ramify in the teguments near the middle line of the body. More posteriorly they furnish also lateral cutaneous branches to the side of the abdomen.

DESCRIPTION OF PLATE XXXIII.

THE internal oblique muscle with the cremaster is depicted in this Figure.

This dissection of the second layer of the groin will be completed by cutting through and reflecting the obliquus externus in the manner shown, and by removing from the fibres of the internal oblique the thin intermuscular layer of areolar tissue.

The nerves and small vessels will be defined as the areolar tissue is cleared away.

SECOND LAYER OF THE GROIN.

Two muscles enter into the second stratum of the groin: of these the chief one is the internal oblique, and to it the cremaster is connected below.

A. External oblique muscle.
B. Tendon of the oblique reflected.
C. Poupart's ligament.
D. Cremaster muscle.
E. Pyramidalis muscle.
F. Spermatic cord.
G. Internal oblique muscle.
I. Band behind Poup. lig.

Internal oblique muscle G. This muscle is distinguished from the preceding by the direction of its fibres; and it arches over the spermatic cord, instead of being pierced by a hole for the same, as the external oblique is. Below it possesses fleshy fibres, where the obliquus externus is tendinous; and these are attached (part of the origin) to the outer half of Poupart's ligament, C, and a fibrous band behind it, I, and to the crest of the hip-bone. From this origin the fibres pass forwards, the upper ascending, and the lower arching over the spermatic cord, to end in the common tendon or aponeurosis.

The aponeurosis of the muscle unites inseparably with that of the external oblique towards the middle line of the body, and ends with it in the linea alba. The part laid bare has the following attachment below:—it is inserted into the front of the pubes, and, farther out, into the pectineal line for half an inch. Above the umbilicus the tendon is split to incase the rectus muscle, but below that point it is undivided, and is continued in front of the rectus.

In the groin the muscle covers the aperture in the abdominal wall through which the testicle escapes, and it conceals in part the spermatic cord. Its lower edge is free, and arches over the cord: contiguous to this edge is the cremaster muscle D. Several superficial nerves and vessels pierce the muscle.

The *cremaster* muscle, D, lies along the lower border of the internal oblique, and covers with loops the spermatic cord. Externally the muscle arises by fleshy fibres from Poupart's ligament below the internal oblique and transversalis, some fibres blending with those muscles; and internally it is inserted by tendon into the pubes and the aponeurosis of the internal oblique. It has the following arrangement with respect to the spermatic cord:—On each side it forms a fleshy bundle, the external being the strongest, and over the front of the cord it gives rise to a series of loops which reach to the testicle. Further the fleshy loops are united

by areolar tissue so as to produce a continuous layer—the cremasteric covering of the cord: this layer is named the cremasteric fascia when it forms an investment for an inguinal hernia.

By the shortening of its loops this muscle can raise the testicle towards the abdomen; its action is chiefly under the control of the will, but at times is involuntary.

Nerves. Three nerves run forwards in the groin between the external and internal oblique muscles: two are offsets of the lumbar plexus, and the other is derived from a dorsal (intercostal) nerve.

1. Ilio-hypogastric nerve.
2. Ilio-inguinal nerve.
3. Cremasteric branch.
4. Branch to pyramidalis muscle.
5. Offset of a dorsal nerve.

The *ilio-hypogastric* nerve, 1, is derived from the lumbar plexus, and has been traced at its ending in the integuments (Plate xxxii. p. 267). In this Illustration of the dissection of the groin, the nerve is shown piercing the internal oblique muscle, near the iliac crest, and the aponeurosis of the external oblique, near the abdominal ring, in its course to the surface of the abdomen.

The *ilio-inguinal* nerve, 2, is an offset with the preceding from the lumbar plexus. Having a similar course with its companion it passes through the internal oblique somewhat lower, and issues from the wall of the abdomen at the external abdominal ring, to reach the scrotum and the integuments of the top of the thigh. It furnishes an offset, 3, to the cremaster, and another, 4, to the pyramidalis muscle.

Last dorsal nerve, 5, runs forward between the oblique muscles, and perforating the aponeurosis of the external opposite the linea semilunaris, ends in the teguments.

Cutaneous vessels. A few unnamed cutaneous arteries with veins perforate the abdominal muscles: the chief of these are situate near the middle line, and are derived from the epigastric vessels.

DESCRIPTION OF PLATE XXXIV.

A VIEW of the transversalis muscle and fascia, with the spermatic cord, appears in the Plate.

Supposing the internal oblique laid bare as in the preceding Plate, this dissection will be made ready by cutting vertically through the lower three inches of the muscle near Poupart's ligament, and reflecting it inwards. The cremaster may be separated afterwards from the cord.

THIRD STRATUM OF THE GROIN.

All the muscles of the abdominal wall come into sight in this Illustration, the transversalis being the deepest ; and under this last muscle lies the fascia transversalis.

A. External oblique muscle.
B. Aponeurosis of external, reflected.
C. Internal oblique muscle.
D. Internal oblique, reflected.
E. Cremaster muscle.
F. Transversalis muscle.
G. Tendon of the transversalis.
H. Conjoined tendon.
I. Fascia transversalis.
J. Infundibuliform fascia.
K. Spermatic cord.
L. Internal abdominal ring.
N. Edge of the rectus muscle.

The *transversalis*, F, is the third flat muscle in the wall of the belly ; and it takes its name from the direction of its fibres. Like the oblique muscles, it is fleshy externally and tendinous internally. The part of the muscle in the groin arises by fleshy fibres from the outer third of Poupart's ligament and the fibrous band behind, and from the iliac crest ; the fibres are directed transversely forwards to the aponeurosis, but the lowest are curved above the cord, as this lies in the abdominal wall.

The aponeurosis unites inseparably with that of the internal oblique, and reaches with it the linea alba. Below, it is attached to the front of the pubes like the internal oblique, and to an inch

of the ilio-pectineal line beneath the tendon of the internal oblique, some fibres blending with the subjacent fascia. Above the umbilicus the aponeurosis lies beneath the rectus; but about midway between the umbilicus and the pubes it is placed over the muscle.

Conjoined tendon H. Near the pelvis the aponeuroses of the internal oblique and transversalis are partly united at their insertion into the pectineal line of the pubes, and form the stratum of the conjoined tendon. But the two do not contribute to its formation in equal proportions, for the aponeurosis of the oblique is about half an inch, whilst that of the transversalis is an inch in width.

Fascia transversalis I. Beneath the transversalis is spread a thin fibrous membrane, which takes its name from being in contact with that muscle. Where the muscle is deficient below the membrane is strongest; and in it is an aperture, L,—the internal abdominal ring, through which comes the spermatic cord. From the margin of the ring a tube of membrane, J, is prolonged around the cord, like a glove on the finger, and is named the funnel-shaped covering of the cord, or the infundibuliform fascia of the inguinal hernia. Outside and below the ring the fascia is thicker and stronger than on the inside where the epigastric vessels appear through it. At Poupart's ligament the fascia descends beneath that band into the thigh, and forms the fore part of the sheath incasing the femoral vessels.

The *internal abdominal* ring, L, is oval in form, measuring most from above down, and is placed about half an inch above Poupart's ligament: on the surface of the abdomen it corresponds with a spot midway between the symphysis pubis and the iliac crest, and a finger's breadth above the ligament of Poupart. It is bounded above by the arched border of the transversalis muscle, F; below by Poupart's ligament; and internally by the epigastric vessels. In this opening lies the spermatic cord, and through it a piece of intestine is protruded in the external inguinal hernia. The tenseness of the margin of the ring, as well as of the fascia in which it is situate, is determined by the position of the limb; for when the thigh is raised and rotated in the whole is relaxed, but when the limb is extended, as in standing, all the strata of the wall of the belly are put on the stretch. This influence of the position of the

limb on the condition of the opening should be kept in mind when an attempt has to be made to return a hernia into the cavity of the abdomen.

Subperitoneal fat. Underneath the transversalis fascia is a layer of fat, varying in thickness with the obesity or leanness of the body, which gives a covering also to the spermatic cord. On looking into an opened abdomen this layer is recognised beneath the peritoneum ; and from this circumstance the name has been obtained.

Peritoneum. Still within the subperitoneal fat is the stratum of the serous membrane of the abdomen, or the peritoneum. This is a thin translucent layer, not now visible, from which an offset in the fetus (processus vaginalis peritonei) was continued around the testicle passing from the abdomen to the scrotum : of this prolongation one or two fibrous bands can be usually discovered in the adult, descending in front of the vessels of the cord, and within the tube of the fascia transversalis.

The *spermatic* cord, K, reaches from the testicle to the opening in the fascia transversalis, and consists of the vessels connecting that viscus with parts in the abdomen. In the groin it lies obliquely amongst the abdominal muscles in a channel called the inguinal canal ; and it predisposes by its situation to the escape of a piece of intestine from the abdomen. Beyond the abdominal wall it hangs vertically to the testicle, and can be felt on the surface of the body.

Roundish in form and about half an inch in diameter, it is composed of the vessels and the efferent duct of the testicle, together with lymphatics and areolar tissue. It is surrounded by coverings from the structures amongst or through which it passes, which come in the following order when enumerated from without in :—the teguments, including the skin, and the superficial fascia or the subcutaneous fatty layer ; the spermatic fascia (Plate xxxii.) ; the cremasteric covering (Plate xxxiii.) ; the funnel-shaped covering (Plate xxxiv.) ; and beneath all the subperitoneal fat. In the fetus at the time of the passage of the testicle there was an additional partial covering of the peritoneum, but this disappears with the subsequent change taking place in the prolonga-

tion from that membrane. These several investments will clothe successively a piece of gut protruding along the cord.

Deep vessels of the groin. Vessels from two sources, the epigastric and circumflex iliac, are met with in this dissection.

a. Epigastric artery and veins.
b. Branches of circumflex iliac.
c. Cremasteric branches of the epigastric.

The *epigastric* artery, *a*, is derived from the external iliac, and ascends obliquely upwards and inwards across the groin to enter the sheath of the rectus muscle. The part now seen lies close inside the internal abdominal ring, and beneath the fascia transversalis.

It furnishes small branches internally and externally: two of the outer set marked with, *c*, enter the cremaster, and receive their appellation from the name of that muscle.

The *circumflex iliac* artery arises from the external iliac opposite the epigastric (Plate xxxv.), and runs beneath the transversalis muscle round the iliac crest. Offsets, *b*, are given to the contiguous muscles.

Veins. Two veins belong to each artery, but they blend into one in each case, and end in the external iliac near Poupart's ligament.

ANATOMY OF INGUINAL HERNIA.

A protrusion of intestine through the wall of the belly in the groin constitutes an inguinal hernia. It may escape through the internal abdominal ring with the cord; or it may be placed still more internally—opposite the conjoined tendon, H. If the gut descends with the cord it lies outside the epigastric artery, and the hernia is called external inguinal. But if the intestine makes a way for itself opposite the conjoined tendon the tumour forms an internal inguinal hernia in consequence of its position inside the epigastric vessels. The differences between these two kinds of hernia will now be adverted to.

External inguinal hernia is directed downwards by the side of the spermatic cord; and it is called also oblique inguinal hernia from its direction in the abdominal wall.

Inguinal canal. The channel in the groin along which the intestine finds its way is the inguinal canal. This is a narrow passage between the muscles, which reaches from the internal to the external abdominal ring. Its direction is oblique downwards and inwards; and its length is about one inch and a half. It is constructed by the strata in the wall of the belly in this manner:—Bounding the canal superficially for its whole length, are the teguments, with the aponeurosis of the external oblique, B; and deeper than the last and at the outer end, is placed the fleshy part of the internal oblique, D, with the cremaster, E. Separating the passage from the abdominal cavity comes first the conjoined tendon, H, for a short distance towards the inner end; and behind it, reaching the whole length, lie the fascia transversalis I, the subperitoneal fat, and the peritoneum.

The upper opening of the inguinal canal, by which the gut enters, is the internal abdominal ring (p. 271); and the lower opening, through which the intestine escapes from the wall of the belly, is the external abdominal ring (p. 264).

Coverings.—A piece of intestine coming forwards through the internal abdominal ring, L, receives investments from the surrounding strata. Some of these exist as tubes around the cord ready for the reception of the nascent hernia, whilst others originate during the protrusion of the intestine. As the intestine is forced gradually onwards it elongates and forms for itself coverings of the peritoneum and the subperitoneal fatty layer. And it is then received into the following tubes around the cord, viz., the prolongation of the fascia transversalis (infundibuliform fascia), the fleshy covering of the cremaster muscle (cremasteric fascia), the intercolumnar layer from the external oblique (spermatic fascia), and lastly the subcutaneous fatty layer (superficial fascia), and the skin. The most internal covering of the intestine, the peritoneal or serous, is named the sac of the hernia. If the gut protrudes through the wall of the belly it will be clothed with all seven of the coverings enumerated above, and will form a complete hernia; or if it enters the scrotum it constitutes a scrotal rupture (oschecele). But if the intestine is stopped in its course

in the abdominal wall it gives rise to an incomplete hernia, or a groin tumour (bubonocele).

Diagnosis.—In distinguishing the external or oblique from the internal hernia the greatest assistance will be derived from the direction and form of the tumour. When it is small, and is still confined to the abdominal parietes, its recognition will be ensured by the swelling taking the direction of the inguinal canal, and leading to the internal abdominal ring where the neck of the tumour sinks into the abdomen; and even an aperture may be recognised with the tip of the finger when the intestine has been pushed back. After the rupture has broken through the bounds of the abdominal wall the swelling becomes flask-shaped with the large end towards the scrotum, and with a narrow neck running upwards and outwards in the groin to the position of the internal abdominal ring. With the aid of the fore finger the hernia may be ascertained to lie in front of and rather to the outer side of the spermatic cord; but this diagnostic mark is not so easy to detect as the oblique position in the groin. The diagnosis is not to be made however under the following circumstances:—When the hernia is large and of long standing the weight of it draws inwards the moveable internal abdominal ring into a line with the external ring, obliterating by that movement the obliquity of the inguinal canal, and causing the external hernia to have a straight course, and the appearance of an internal hernia.

Taxis.—The success of attempts to replace a piece of intestine in the cavity of the abdomen will depend mainly upon the manipulator keeping in remembrance the direction of the inguinal canal, and the influence of the position of the limb upon the tightness of the structures in the groin. Before the taxis is employed the recumbent posture is required, and the thigh is to be raised and rotated in, so that the apertures through which the gut escapes, and all the strata in the groin, may be relaxed as much as possible. To effect the reduction the operator grasps the end of the tumour with one hand, using gradual and uniform pressure over the surface, whilst with the two fore fingers of the other hand he endeavours to direct upwards through the narrowed neck of

the tumour in the groin some of the accumulated fluid and gaseous contents of the gut. In this proceeding success will be more likely to attend on the efforts of the person who is mindful of the position of the internal abdominal ring, and of the obliquity of the inguinal canal, than on the attempts of him who may disregard, or may not be acquainted with those facts. Gentle and general pressure continued perseveringly will be always more effective than force applied partially and only for a short time, in evacuating the contents of the intestine, and in returning the gut into the cavity of the belly.

Position of a Truss.—After a hernia has been reduced it must be kept in the abdomen by a truss. In the external inguinal hernia the pad of the truss should close the internal abdominal ring; and it should be applied to a point in the groin half an inch above Poupart's ligament, and about midway between the pubes and the front of the iliac crest. In the other kind of inguinal hernia (internal) the pad of the truss will occupy a different position (p. 281).

Stricture.—If the intestine cannot be restored to its natural cavity by the taxis, the contents of the alimentary canal accumulate in it; and the veins in the wall of the gut being compressed by the edge of the narrowed hole of one of the abdominal rings (generally the internal) are incapable of returning their contents, and swelling, and more or less complete stagnation of the flow of blood ensue. In this way the intestine may be strictured or strangulated, according to the degree of completeness of the arrest of the circulation. The constriction may be placed at the internal abdominal ring; at the external ring; or more rarely at the lower edge of the internal oblique muscle. The most usual site of stricture is at the internal abdominal ring, and it may be produced in two ways:—either it results from a constricting band of fibrous tissue outside the peritoneal sac; or from a thickening of the peritoneum itself at the neck of the hernia, so as to form a sharp firm band inside the sac, by which the arrest of the circulation may be brought about when the fæces accumulate in the intestine and increase its size as before explained.

Division of the Stricture.—Division of the band impeding the

return of the intestine is to be effected by the operation for hernia. The seat of stricture cannot be ascertained beforehand, but as it is placed most frequently at the internal abdominal ring the incisions are planned with the view of laying bare the neck of the hernia; and as there are two kinds of stricture—one outside, the other inside the sac of the hernia, the mode of proceeding will vary with each. All fibrous bands outside the neck of the sac are first divided in an operation, and an endeavour is to be then made to push gently back the intestine into the abdomen; but if the gut cannot be passed through the narrowed aperture with the employment of moderate force, the peritoneal sac is to be opened below the neck, and the constricting band is to be cut from within out on a director introduced beneath it in a longitudinal direction.

Should the operator ascertain that the stricture is not situate at the internal abdominal ring, he must seek it lower down at the border of the internal oblique, or at the external abdominal ring, as before said. Supposing the constriction to be present at one of those spots, an attempt should be made in the first instance to relieve the intestine after the manner above explained, and without opening the peritoneal sac.

Varieties of external hernia.—Differences in the state of the peritoneal covering or sac of this hernia give origin to two varieties. Usually these occur in the male infant, and child; but they may be present in the adult male if the peritoneum has the same arrangement as in infancy, in consequence of an arrest in the changes commonly ensuing on the passage of the testicle. One of the two varieties is called congenital, and the other infantile hernia.

Congenital inguinal hernia differs from the ordinary external hernia in not protruding as a covering for itself a piece of peritoneum to form the sac. In this kind the intestine descends in the unclosed peritoneal pouch (processus vaginalis peritonei) whicha ccompanied the testicle at the time of the passage from the abdomen to the scrotum; and consequently it touches the testicle, reaching downwards in front of, and below that viscus.

Its coverings are similar to those of an ordinary external hernia,

but its peritoneal covering or the sac is obtained in a different way as just said.

Congenital hernia would be recognised both in the infant and the adult by the extent of the descent of the intestine, for this reaches as far as the lower end of the testicle or beyond it; whilst in the common external hernia the tumour is stopped on a level with the top of the testicle as it progresses into the scrotum.

What has been before detailed respecting the taxis and the application of a truss, the seat and the division of the stricture in external inguinal hernia, will apply to this and the following variety of the same kind of rupture.

Infantile hernia is due like the congenital to an unobliterated state of the processus vaginalis peritonei of the testicle; and it received its name from being first recognised in children. The state of the peritoneum necessary for the formation of this hernia is the following:—Commonly the vaginal pouch of peritoneum of the testis is obliterated in the fetus from the internal abdominal ring down to the testicle; but sometimes it is obliterated only a very short distance from that opening, so as to leave a larger sac than usual around the testis, which reaches upwards along the spermatic cord and the inguinal canal. This developmental deviation once produced remains permanently, and will give rise at any period of life to the hernia called infantile.

With the presence of the state of the peritoneum above described, should an external hernia take place, it would push before it in the usual way a sac of the peritoneum with the subperitoneal fat; then it would pass through the internal abdominal ring, and be received into the tubes or coverings incasing the spermatic cord (p. 274). But as it makes its way along the inguinal canal and the cord it comes to be placed behind the loose unclosed pouch of the peritoneum already referred to. In reality there would be two separate serous sacs in connection with this kind of hernia;—an anterior consisting of the tunica vaginalis testis which would contain only serum; and a posterior, the sac of the hernia, opening into the cavity of the belly, in which the intestine is lodged.

Though this rupture may be found in the adult as well as in

the child, like the congenital kind, there is not any sign by which it can be distinguished during life from the common external hernia.

Evidence of the existence of an infantile hernia is first obtained in an operation for the relief of the strangulation. Then as the knife is moved onwards to divide the stricture it opens the loose sac of the tunica vaginalis, in which a serous fluid is generally collected. Should the stricture be placed inside the neck of such a hernia the hinder second sac would have to be cut into before the intestine would be laid bare.

Internal inguinal hernia comes through the abdominal wall at a spot internal to the epigastric artery, and obtains its name from its position inside that vessel. It takes a straight course through the parietes of the abdomen opposite, H; and it is named also direct hernia from its straightness in comparison with an external hernia.

The terms complete and incomplete, bubonocele and oscheocele (p. 274), may be applied to this as well as to the external hernia.

Triangular space of the groin.—Inside the epigastric vessels is the triangular space of Hesselbach, in which the internal rupture comes forth. It is bounded externally by the vessels, *a*; internally by the edge of the rectus muscle, N; and below by Poupart's ligament. In width it measures about one inch and a half at the base, and from base to apex about two inches.

The following is the arrangement of the strata within the space above defined. Firstly come the teguments, consisting of the skin, and the subcutaneous fatty layer or the superficial fascia. Beneath the teguments the aponeurosis of the external oblique, B, covers all the triangular space, and is pierced by the large external abdominal ring. When this has been reflected the spermatic cord, clothed by the cremaster muscle, E, is seen to lie along the base of the space. Still deeper is the conjoined tendon, H, which is formed by the union of the aponeuroses of the internal oblique, D, and transversalis, F (p. 271): this aponeurotic layer is not wide enough to cover the whole of the space included between

the edge of the rectus and the epigastric vessels, therefore there is an interval about half an inch wide between its outer border and the epigastric vessels, in which the next stratum appears. Under the muscles the transversalis fascia, I, the subperitoneal fat, and the peritoneum, are stretched continuously over the area of the space, and without apertures in them.

Coverings. The position of the hernia in the triangular interval is determined by the existence of a pit or fossa on the inside of the abdominal wall opposite, H, (Plate xxxv.); and it is at this point, behind the conjoined tendon, where the hernia is most commonly found. As the external oblique is the only layer with an aperture in it, and with a tube descending from its margin, all the coverings of the rupture, except that one, will be formed anew, being elongated from the several strata as the intestine gradually makes its way onwards. The intestine in advancing extends firstly the peritoneum and the subperitoneal fat, forming the sac out of the former of the two. Then it pushes forwards the fascia transversalis, and obtains for itself another thin covering. Nextly, meeting with the obstructing conjoined tendon, it elongates the same; or, if the hernia is produced suddenly, the tendon may be slit to give passage to the tumour. Still advancing, the rupture passes over the cord and the cremaster muscle, and escapes through the external abdominal ring, where it receives the investment of the spermatic fascia. And lastly it comes to be placed under the superficial fascia and the skin, as it descends along the spermatic cord.

Diagnosis. As this hernia enters the wall of the belly nearer the mid line than the internal abdominal ring, and takes withal a straight course, it comes to lie rather inside the spermatic cord as it escapes through the external abdominal ring, and rather over the pubic crest. But the best diagnostic marks between this and an external hernia are, the straightness and shortness of its passage through the abdominal parietes, and the absence from the inguinal canal of a narrowed oblique neck. An internal hernia cannot be distinguished from an external when the last is large, and has been of long standing (p. 275).

Taxis. When the rupture has to be reduced success will be

greatly dependant upon a correct diagnosis of its kind, because the spot at which the internal leaves the abdominal cavity is different from that for the external ; and attempts which would be useful when the kind of hernia is recognised might be injurious when it has been mistaken. In the case of an internal hernia the passage along which the fæces have to be directed is quite straight through the abdominal wall, and in the direction of a line carried inwards through the external abdominal ring. When the taxis is about to be used the first requisite is to have the structures in the groin relaxed by placing the trunk in the recumbent posture, and by raising the thigh and rotating it inwards. And during the employment of the taxis the fundus of the tumour should be compressed evenly and steadily with the grasp of the one hand, whilst the fore fingers of the other are used to direct upwards some of the contents of the intestine.

Position of the Truss.—In applying a truss for an internal hernia the pad of the instrument is to be placed on the hole in the aponeurosis of the external oblique muscle, because the aperture of entrance into the wall is opposite the aperture of exit from the same. This opening, or the external abdominal ring, will be opposite a spot on the surface of the body immediately outside the pubic crest.

Seat of Stricture. The band constricting the intestine may be found at two places. Firstly it may exist at the narrowed mouth of the sac, and may be produced by fibrous tissue external to that part, or by a thickening of the wall of the sac inside the neck. Secondly it may result from the firm sharp margin of the external abdominal ring.

Division of the Stricture. Partial or complete arrest of the circulation in the intestine follows on inability to reduce the rupture by the taxis ; and an operation is needed to set free the gut from its imprisonment, and to arrest its mortification. An incision is to be made through the wall of the belly down to the neck of the tumour, to remove stricture external to the sac ; but should this proceeding fail in its object, and the existence of stricture inside the neck of the sac be made thereby probable, the peritoneal covering should be opened, and the constricting band should be

divided directly upwards by means of a knife carried along a director inserted under it.

As a large apparently internal hernia, with a straight direction through the abdominal wall, may have begun as an external or oblique one, and may have assumed afterwards the look of an internal rupture by reason of its weight (p. 275), the scalpel should be kept on the front of the tumour in an operation, and parallel to the middle line of the body. And in dividing the stricture the cut should be made directly upwards in the same direction. By taking these precautions the danger of wounding the epigastric vessels curving around the neck of such a hernia on the inner side will be best avoided.

Variety of internal hernia.—Within the triangular space of Hesselbach a rupture may protrude at a different spot from that above mentioned. External in position to the other, it will be placed nearer the epigastric vessels, *a*, coming out between them and the edge of the conjoined tendon, H. Without any aperture for its exit, it has to elongate and make coverings for itself, like the common form of internal hernia which lies nearer the pubes.

Course and coverings. The Drawing demonstrates the oblique course the intestine would take through nearly the whole of the inguinal canal. As the rupture is placed farther out in the triangular space than the conjoined tendon it will want necessarily a covering from that stratum; and it differs from the more common internal hernia in not possessing that investment. But as the intestine proceeds along the inguinal canal and the cord it slips within the cremaster muscle, and then issues from the abdominal wall by the external abdominal ring, forming a pear-shaped swelling.

Its coverings from within out will be, peritoneum or sac, subperitoneal fat, fascia transversalis, cremasteric fascia, spermatic fascia, and the teguments and skin: in short they are the same as to number and structures as the coverings of the external or oblique hernia.

Diagnosis.—During life this kind of the internal hernia is not to be distinguished from the external or oblique in consequence of

its traversing so much of the inguinal canal, and having a pear-shaped form like that rupture.

Taxis and the truss.—From an inability to distinguish this tumour from an external hernia, which it would resemble, the same precautions for insuring the return of the intestine by the taxis are to be taken, as were described for that rupture (p. 275). And the pad of the truss, which is to keep the gut in its cavity, should be placed near the situation of the internal abdominal ring, or where an aperture can be recognised by the tip of the fore finger.

Seat of stricture. The remarks before made on the cause and situation of the stricture of an external hernia will serve for this rarer kind of internal hernia (p. 276).

Division of the stricture. With a suspicion of the existence of the kind of rupture now under consideration care is needful in cutting down to free it from stricture ; for the epigastric vessels lie on the outer side, whilst in the external hernia, from which it cannot be distinguished, they are placed on the inner side of the neck of the rupture. In cutting down on the upper part of the hernia to divide the external stricture the scalpel should be kept well on the front and midpart of the tumour, so as to avoid the vessels lying on its side, after the manner recommended in the operation on the doubtful large direct hernia (p. 282) ; and in dividing the internal stricture of the neck, after opening the sac, the cut should be made directly upwards in front of and opposite the middle of the hernia. Should these directions be observed there will be little risk of injuring the bloodvessels, even though the diagnosis between the two kinds of hernia cannot be established.

DESCRIPTION OF PLATE XXXV.

INNER view of the groin with the apertures through which the intestine leaves the cavity of the abdomen in hernia.

To prepare the dissection throw down the wall of the abdomen in the left groin in the form of a triangular flap; detach the peritoneum and the subperitoneal fat from that flap, and the colon from the iliac fossa. On the removal of the fat and areolar tissue, and some glands from the side of the large iliac artery and vein, the different smaller vessels and nerves will come into sight.

By separating the peritoneum from the wall of the pelvis the urinary bladder and the obturator vessels appear; but in the dissection here delineated the obliterated hypogastric artery was removed from the bladder.

INNER STRATA OF THE ABDOMINAL WALL.

Inside the muscles of the abdominal wall in the groin are spread some thin membranes, which are connected with hernia, forming coverings for it. In the inner as in the outer view the firm band of Poupart's ligament appears.

A. Rectus abdominis under the fascia.
B. Crural arch.
C. Gimbernat's ligament.
D. Iliac fascia.
E. Sigmoid flexure of the colon.
F. Internal abdominal ring.
G. Crural ring.
H. Pectineus muscle covered by fascia lata.
I. Inner inguinal fossa.
J. Urachus of the bladder.
K. Vas deferens of the testis.
L. Fascia transversalis.
N. Urinary bladder.

Peritoneum and *subperitoneal* fat. These two layers have been necessarily detached in the dissection: they cover all the parts now laid bare, separating them from the viscera, and they close the aperture of the internal abdominal and the crural ring.

The *crural arch*, B, or Poupart's ligament (p. 264), stretches

across the front of the hip-bone, arching over the muscles, vessels, and nerves, which are continued from the cavity of the abdomen to the thigh. Rounded externally where it is joined to the hip-bone and is united with the subjacent parts, it is separated internally by the iliac vessels from the underlying muscles and bone, and is fixed by a widened part (Gimbernat's ligament) into the tuberosity and the pectineal line of the pubes.

Gimbernat's ligament, C, is that part of the widened inner attachment of the crural arch, which intervenes between the rounded anterior part, B, and the bone beneath. Triangular in shape, the apex is inserted into the tuberosity of the pubes, and the base is turned to the iliac vein, *b*. From apex to base it measures about an inch, and it is kept on the stretch by its union at the base with the fascia lata.

The *fascia transversalis*, L, lines the wall of the abdomen as low as Poupart's ligament. Ceasing opposite that band, it has a different disposition at the outer and inner ends. As far inwards as the letter B, it is connected to the ligament, and blends with the iliac fascia, D: between the spot referred to and Gimbernat's ligament it is continued beneath the inner half of the crural arch, and enters the fore part of the loose crural sheath around the femoral vessel; and still more internally it is fixed into the pectineal line of the pubes beneath the conjoined tendon (p. 271) and Gimbernat's ligament. Just above Gimbernat's ligament is a depression in the fascia, forming the inner inguinal fossa, I, where the internal inguinal hernia begins to protrude.

Internal abdominal ring, F. This is an elongated aperture in the fascia transversalis, which is external to the epigastric vessels, and a little above Poupart's ligament. Through it pass the constituents of the spermatic cord, viz. the spermatic vessels, *c*, the vas deferens or duct of the testis, K, part of the genito-crural nerve, 1, and lymphatics: when these have reached the inside of the abdomen they diverge to their destination beneath the peritoneum and the subperitoneal fat. Before the dissection is made the aperture will be closed by the two internal strata of the abdominal wall, viz. subperitoneal fat and peritoneum; but in the state of the parts necessary for the production of a congenital

hernia, the ring is not closed by those layers, but remains patent for the escape of the gut; whilst the two strata (peritoneum and subperitoneal fat) form tubes which reach to the testicle and are ready to receive the descending intestine.

In an external inguinal hernia the piece of intestine leaves the abdominal cavity through this hole, and protrudes along the spermatic cord. Of necessity the gut will force onwards, and make coverings for itself of the peritoneum and the subperitoneal fat, as already said (p. 274), before it receives the other coverings from the abdominal wall.

The *fascia iliaca*, D, covers the iliacus muscle, and lies beneath the large external iliac blood-vessels. At Poupart's ligament it joins the fascia transversalis as far inwards as B: but thence to Gimbernat's ligament it is prolonged beneath the iliac artery and vein, and blends with the hinder part of the loose crural sheath on the femoral vessels.

The *crural sheath* (Plate XLIII.) is continuous above with the fasciæ just noticed, the fascia transversalis entering the front, and the fascia iliaca the back of the tube. In it are lodged the great vessels, *a* and *b*, of the limb; and as these occupy only the outer part of the sheath in consequence of the shape of the parts, an interval is left between the iliac vein, *b*, and Gimbernat's ligament, which is named the *crural canal*. This canal gradually tapers from above down, and reaches but a short distance along the crural sheath: its opening into the abdomen is called the *crural ring*. A femoral hernia passes through this space or passage in the crural sheath.

The *crural ring*, G, is the aperture of entrance into the crural canal from the cavity of the abdomen. About as large as the tip of the fore finger, and flattened like this from before back, it is bounded in front by Poupart's ligament and the subjacent band of the deep crural arch; behind by the pubes covered by the pectineus muscle and fascia lata; internally by the base of Gimbernat's ligament, C; and externally by the iliac vein, *b*. Of these boundaries only the anterior and inner are unyielding and sharp enough to constrict a piece of gut lying in it. If the fore finger is placed in the ring whilst the hip-joint is alternately

flexed and extended the influence of the state of the limb on the margins of the ring will be perceived; for laxness of Poupart's and Gimbernat's ligament will be induced by raising the thigh, and tightness of those bands will follow straightening of the limb.

The ring is filled by a lymphatic gland, and transmits lymph-vessels from the thigh to the abdomen. Towards the cavity of the belly it is closed by the strata of the peritoneum and subperitoneal fat. But the subperitoneal layer is thickened over the crural ring, and is projected downwards into that aperture, making thus a partition between the limb and the abdomen; and from this arrangement the term *septum crurale* was applied to it by M. Cloquet.

Vessels occupy the outer side and the front of the ring. In the former situation is the iliac vein, *b*. In the latter lie a small pubic branch, *f*, of the epigastric vessels, and deeper amongst the muscles, the spermatic vessels of the testis. Occasionally the obturator artery, *g*, arises from the epigastric, *c*, above the ring, and descends into the pelvis close to the iliac vein, and along the outer part of the ring. With the same origin it may course to the pelvis along the base of Gimbernat's ligament, at the inner part of the ring: when it thus occupies the inner side, the ring will be encompassed by vessels except at the back.

Obturator or *subpubic aperture.* Below the brim of the pelvis is a third aperture, which transmits from the abdomen the obturator vessels and nerve. It is a small oblique canal at the upper part of the thyroid foramen; and it is bounded partly by bone, and partly by the obturator membrane and muscle. Like the two apertures before described, it is separated from the cavity of the abdomen by the peritoneum and the subperitoneal fat.

Occasionally a piece of intestine leaves the abdomen through this hole, forming an obturator hernia. In such a case the tumour would be clothed by the peritoneum and the subperitoneal fat, like the other herniæ, and it would finally escape into the thigh under the pectineus muscle. Very commonly small pellets of fat from the subperitoneal layer project through the aperture.

ANATOMY OF FEMORAL HERNIA.

A protrusion of intestine below Poupart's ligament to t thigh gives rise to a femoral hernia. Part of the anatomy of t hernia can be studied in the abdomen, and part with the lo limb; but only the facts illustrated in this Plate of the dissecti of the groin will be here alluded to.

Course. Entering the loose crural sheath through the cru ring, the gut descends on the inner side of the femoral vein alo the narrow space of the crural canal, as far as the sapheno opening in the fascia lata; at this spot it escapes from its narro passage through the saphenous opening, and forms a swelling the surface of the thigh. As it proceeds in its course it displace or causes to be absorbed the gland situate in the crural cana Whilst it is in the crural sheath the gut has nearly a straigh direction, but as it projects forwards to the surface a bend formed at the level of the saphenous opening; and as it increase in size, ascending on the abdomen, a second bend is produced See the description in the thigh. The narrowed part of th tumour beneath Poupart's ligament is named the neck of th hernia.

Coverings. The intestine pushes before it some strata apper taining to the wall of the belly, and others belonging to th thigh. The coverings derived from the abdomen are the peri toneal or the sac, and the subperitoneal or fatty layer whic varies much in thickness in different bodies. The limb-covering are obtained from the crural sheath, and the teguments, and wil be described with Plates XLI. and XLII.

Taxis. By the view in the Plate it appears that the return o the intestine will be retarded by the tendinous band of Poupart' and Gimbernat's ligament, if this is kept tight by an extended state of the thigh; and therefore the thigh should be raised and rotated inwards to relax to the utmost that band during the employment of the taxis.

Stricture. Strangulation of the intestine takes place most com- monly in the neck of the rupture. It may be outside the sac,

and be caused by a fibrous band, or by the sharp tendinous edge of Poupart's and Gimbernat's ligament; or it may be placed inside the sac, being produced by a thickened band of peritoneum.

Division of the stricture. When all attempts to relieve the constriction of the gut, by cutting fibrous bands external to the neck of the sac, have failed, the sac will have to be opened, and the knife introduced under Poupart's ligament into the lower part of the belly. In dividing the internal stricture the edge of the knife should be turned inwards because the inner side of the crural ring is usually free from any blood-vessel; but the cutting instrument should not be introduced farther than is necessary, for if the bladder should be distended, so as to project above the level of the brim of the pelvis, it may be injured in an operation.

Occasionally the obturator artery lies along the inner side of the crural ring (p. 287). When this unusual condition exists the vessel is close inside the neck of the hernia, and would most probably be cut by the knife carried inwards as above directed. Fortunately this exceptional state is very rare in conjunction with a hernia requiring an operation for the relief of strangulation inside the neck of the sac.

EXTERNAL ILIAC VESSELS.

The topographical anatomy of the lower half of the external iliac vessel,—the part of the artery to which a ligature may be applied—is represented in this Illustration.

a. External iliac artery.
b. External iliac vein.
c. Spermatic artery.
d. Circumflex iliac artery.
e. Epigastric artery.
f. Pubic branches of epigastric.
g. Obturator artery.
h. Epigastric vein.
i. Circumflex iliac vein.
k. Obturator vein.
l. Spermatic vein.

The *external iliac, a,* is the beginning of the main artery of the lower limb, and is contained in the cavity of the abdomen. It reaches from the base of the sacrum to the lower border of Poupart's ligament, where it receives the name "femoral." It has a straight course above the brim of the pelvis, and takes the psoas muscle as its guide.

In all its extent the vessel is covered by the peritoneum and the subperitoneal fat; and it is accompanied by a chain of lymphatic glands on the inner side and the fore part. Towards its lower end numerous smaller vessels lie on it: thus the spermatic artery and vein, *c*, and the genital branch, 1, of the genito-crural nerve pass along it; crossing over its inner side for a short distance is the vas deferens of the testis, K; and directed transversely over it near its ending is the circumflex iliac vein, *i*. To its inner side, and taking a deeper position than it, is the external iliac vein, *b*; but on the right side there is a slight difference in the position of the vein (Plate xxxvi.).

Two branches for the wall of the abdomen, viz. circumflex iliac and epigastric arise from the lower end of the vessel.

Ligature of the artery. The slight depth of the external iliac, and the small disturbance of the contents of the abdomen in the attempt to reach it, render practicable the ligature of this vessel by cutting through the wall of the belly in the groin.

Not to displace unnecessarily the peritoneum the ligature should be kept as near as it can be to Poupart's ligament; but the exact spot to be selected for the application of the thread will be determined by the position of the branches. Usually two branches arise near the end of the artery, and on opposite sides of it; and if the position of these vessels was constant the trunk might be tied about an inch higher up. But as these branches take origin at different distances (one to two inches, Quain) from Poupart's ligament, and as the obturator artery may be attached also to the lower half of the iliac trunk, the spot selected for ligature should be one inch and a half to two inches above the crural arch.

The operation may be practised in this manner. A cut is to be made through the integuments of the wall of the belly in the groin from a point a little above and outside the internal abdominal ring to the front of the iliac crest; but on the right side the cut will be reversed. The three muscular strata are divided successively down to the yellow-looking fascia transversalis, L; and then this thin membrane may be slit on a director. Next, the peritoneum and the subperitoneal fat are to be detached carefully with the finger, without rupture, from the iliac fossa.

On looking into the wound, with the light falling into it, the artery will be seen in the bottom; and after slightly detaching the iliac trunk from the surrounding parts, a ligature may be readily applied to it. Should the origin of a branch come into sight when the trunk is laid bare it may be included in the thread.

Difficulty in the execution of the operation may be due to enlargement of the contiguous inguinal glands, which may cover the arterial trunk and are detached from it with difficulty. Variation in the situation of the artery will give rise to some embarrassment unless the operator is previously acquainted with it. Not uncommonly the vessel is much bent downwards into the pelvis, so as to lie below the brim, and to be out of sight: in such a condition the artery would have to be raised to its usual level by the fore finger introduced into the wound, before a ligature could be passed around it. Sometimes in detaching the subperitoneal fat the external iliac is raised from its usual situation, and is carried upwards with that layer: when this displacement occurs the vessel may be detected in the fatty layer by means of the pulsation.

Branches of the iliac. The two branches of the artery ramify in the wall of the belly, one in front and the other behind. Only the beginning of the branches can be now seen.

The *epigastric* artery, *e*, ascends on the inner side of the internal abdominal ring to the rectus muscle. At first it lies beneath the fascia transversalis, but finally perforates this membrane to enter the sheath of the rectus. On each side of the artery lies a vein; these join below into one.

Small branches, *pubic*, run inwards to the back of the pubes, anastomosing with their fellows, and the obturator, *g*. *Cremasteric* offsets (p. 273) are supplied to the muscular covering of the cord.

The *circumflex iliac* artery, *d*, is directed to the iliac fossa below Poupart's ligament (Plate xxxvi.). Small muscular branches are given by it to the abdominal wall and the iliacus.

Two other small arteries, the spermatic and obturator, come into the dissection for a short distance.

The *spermatic* artery, *c*, a branch of the aorta, courses to the testis through the internal abdominal ring. The veins accompanying it unite together higher in the abdomen (Plate xxxvi.).

The *obturator* artery, *g*, arises from the internal iliac trunk in the pelvis, and issues through the subpubic aperture to the thigh. Its companion vein, *k*, and nerve, 4, have a like course.

The *nerves* in the dissection are offsets of the lumbar plexus, and are represented more fully in the two following Plates.

1. Genital branch of genito-crural.
2. Crural branch of genito-crural.
3. External cutaneous nerve.
4. Obturator nerve.

The *genito-crural* nerve divides into two:—The genital branch, 1, runs on the external iliac artery, and issues through the internal abdominal ring to supply the cremaster muscle; the crural branch, 2, passes beneath Poupart's ligament to the integuments of the thigh.

The *external cutaneous*, 3, is directed under the outer end of Poupart's ligament to the teguments of the thigh.

The obturator nerve, 4, escapes from the abdomen by the subpubic hole with the vessels of the same name, above which it lies: it is distributed in the thigh.

DESCRIPTION OF PLATE XXXVI.

THE deep muscles and the vessels of the abdominal cavity are figured in this Plate.

The objects here represented will be readily cleaned after the removal of the viscera from the cavity of the abdomen; but as the large vein (vena cava) is imbedded in the substance of the liver it is usually cut away in the removal of that viscus. To denude the diaphragm, dissect off with care the peritoneum; to remove that membrane from the tendon of the muscle, to which

it adheres closely, will require some skill on the part of the dissector.

On the right side the deep muscles are to be laid bare, but on the left the fascia covering them may remain entire.

The small nerves issuing from the substance of the psoas muscle lie in a loose fat, and can be defined with ease.

MUSCLES IN THE ABDOMINAL CAVITY.

One of the muscles (diaphragm) separates the cavities of the thorax and abdomen, and is used in respiration; the others, placed on the side of the spine, take part in the movements of the lower limb and last rib.

A. Fleshy part of the diaphragm.
B. Mid-part of the tendon.
C. Left piece of the tendon.
D. Right piece of the tendon.
E. Right crus.
F. Left crus.
G. Internal arched ligament.
H. External arched ligament.
I. Quadratus lumborum.
J. Psoas parvus muscle.
K. Psoas magnus.
L. Iliacus muscle.
M. Urinary bladder.
N. Rectum.
O. Vas deferens of the testis.
P. Left ureter.
Q. Left kidney.
R. Supra-renal body.
S. Œsophagus, cut.
T. Pectineus muscle.

The *diaphragm*, A, stretches across the hollow included by the ribs, and divides this space into two,—an upper part, cavity of the thorax; and a lower or abdominal cavity. The muscle is fleshy at the circumference where it is fixed to the ribs, and tendinous in the centre.

The diaphragm takes origin externally from the back of the xiphoid cartilage; from the six lower ribs on the inner surface; from the two arched ligaments, H and G; and from the side of the spinal column by the crus, E. All the fleshy fibres end internally in the central tendon, to which they are directed with varying lengths and inclinations.

It is arched unequally on the two sides, being highest on the right. Its surfaces look upwards and downwards to the thoracic and abdominal cavities; and they differ in form, for the upper is

convex, and the lower concave. In contact with the upper are the viscera and membranes of the thorax; and the lower, clothed by the peritoneum, touches the larger viscera in the abdominal cavity. Three large tubes—two for the conveyance of blood (aorta and cava), and one of the food (œsophagus)—pass through the muscle; and smaller apertures for the transit of vessels and nerves exist on each side. In the dead body the muscle is arched higher on each side than in the centre, and the bulge on the right is higher than that on the left. The right curve ascends as high as the upper border of the cartilage of the fifth rib near the sternum, and the left reaches in like manner to the level of the sixth rib. By the action of this muscle the cavities of the abdomen and thorax are enlarged and diminished, and the viscera are compressed alternately.

During contraction or shortening of the fibres the muscle moves down slightly in the cavity of the abdomen, diminishing this space and enlarging the thorax; and as the fleshy or lateral part moves more than the central or tendinous the whole muscle resembles in form a flat-roofed tent. In consequence of an increase in the size of the thorax during its contraction it acts as an inspiratory muscle. By the descent above indicated the viscera in the upper part of the abdomen are forced down; and if the diaphragm be fixed in that position, whilst the abdominal muscles are contracted, the viscera will be compressed between the two, and the contents of some may be expelled.

When the shortened fibres relax and lengthen the muscle is moved one rib higher on both sides than its level in the dead body; and it diminishes in this way the cavity of the thorax, whilst it increases proportionally that of the abdomen. By causing a decrease in the cavity of the thorax it becomes an expiratory muscle. In its ascent the viscera of the thorax are raised, especially the heart, and those in the abdomen regain their usual place.

Named parts of the muscle. These are three, viz., the central tendon, the pillars, and the arched ligaments.

The *central tendon*, not attached to bone, is a thin aponeurotic layer, which is shaped like a trefoil leaf, and has been called

heart-shaped or cordiform. It receives by its circumference the fleshy fibres, and is pierced by the large inferior cava: it is divided into three pieces;—a central, B; a left narrow portion, C; and a right piece, D.

The *crura* or *pillars* lie on the sides of the aorta, *a*, and form two thick fleshy bundles which are fixed by tendon to the subjacent lumbar vertebræ and their intervertebral substance. Of the two, the right crus is larger than the left, and in the succeeding Plate it may be seen more distinctly. From the tendinous part the fleshy fibres ascend to the central tendon, but the most internal set pass between the aorta and the œsophagus, decussating with their fellows, and bound laterally the œsophagean opening in their upward course to their destination. Most commonly the fasciculus of the right side is anterior to that of the left at the point of crossing.

The *arched ligaments* are fibrous bands over the loin-muscles for the purpose of giving attachment to the fibres of the diaphragm.

The internal one, G, (ligam. arcuat. intern.) the longest and most curved, lies over the psoas muscle. By the inner end it joins the tendinous part of the crus, and by the outer it is inserted into the transverse process of the first lumbar vertebra. The external band, H, (lig. arc. extern.) is attached externally to the last rib, and internally it blends with the inner ligament: it is placed over the quadratus muscle, I, and under or through it the last dorsal nerve and the accompanying artery issue.

Apertures in the diaphragm. Three large central holes give passage to the œsophagus and the two large bloodvessels of the lower half of the body; and on each side of the aorta is a fissure in the crus for the transmission of the splanchnic nerves.

The *œsophagean opening* occupies the fleshy part of the muscle behind the central tendon. It is placed in front of the spinal column, above and to the left of the aortic opening. Its bounding fibres are derived from the crura, those on the left side coming from the right crus; and the opposite. Through this aperture are transmitted the œsophagus, and the two pneumo-gastric nerves, with areolar tissue. It is larger than the tube passing

through; and it will be reduced in size by the contraction of the fleshy fibres.

The *opening* for the *vena cava* (for. quadratum) lies on the right of the œsophagean, and higher than it. It is situate in the central tendon near the back part. Its margins blend with the coat of the vein, except on the inner side; and its size will not be diminished during the contraction of the fleshy fibres of the diaphragm. It gives passage to the vena cava inferior, and some areolar tissue.

The *aortic opening* is rather behind than in the diaphragm, and is opposite the last dorsal vertebra. Laterally it is bounded by the pillars of the diaphragm; and in front by a narrow tendinous band which intervenes between the crura. Through it pass the aorta, the thoracic duct, and the large azygos vein, with areolar tissue.

The *fissure* for the *splanchnic nerves* (Plate xxxvii.) lies in the fleshy part of the crus, and transmits on the right side the splanchnic nerves. Through that on the left side, besides the three corresponding nerves, passes the small azygos vein.

The *psoas magnus* muscle, K, occupies the loins, and leaves the abdomen beneath Poupart's ligament to be attached to the femur with the iliacus.

The muscle arises from the bodies of the lumbar vertebræ and their intervertebral substance; from the body of the last dorsal; and from the transverse processes in the loins by aponeurotic slips. Inferiorily it ends in a tendon, which is continued to the thigh, and is inserted into the small trochanter of the femur.

The psoas lies beneath the kidney and the large intestine, and the ureter and the spermatic vessels. At the attachment to the lumbar vertebræ fibrous arches span over the lumbar vessels; and along its inner edge below the spinal column rest the external iliac vessels. The outer edge overlays the quadratus lumborum, I, and the iliacus, L, and some nerves of the lumbar plexus.

If the femur is free to be moved this muscle will raise it towards the abdomen, bending the hip-joint; and afterwards will rotate out the limb. When the limb is immovable, as when it supports the weight of the body, the muscle will draw forwards

the trunk over the femur, as in stooping. In standing the lumbar part of the spine is kept erect by the action of both muscles; or is bent to the side by one.

The *psoas parvus* muscle, J, appears to be but a part of the large psoas: it is often absent.* It takes origin from the bodies of the last dorsal and first lumbar vertebræ, and from the intervertebral substance; and it ends below in a strong tendon, which is inserted into the fore part of the brim of the pelvis, blending with the iliac fascia. Near the ribs the muscle lies on the psoas magnus, but slips to the inner side of this muscle below.

As the muscle is not fixed to the femur it cannot act on the hip-joint. In the recumbent posture it may raise forwards the pelvis; and in standing it assists the large psoas in supporting and bending forwards the lumbar part of the spine.

Quadratus lumborum, I. This muscle fills the space between the last rib and the iliac crest, and is best displayed in Plate xxxvii. Two to three inches wide below, the muscle arises from the ilio-vertebral ligament, and the crest of the hip-bone behind that band: it is inserted internally into the transverse processes of the four upper or all the lumbar vertebræ, and into the last rib and the body of the last dorsal vertebra.

The quadratus is partly concealed by the psoas, and is contained in a sheath derived from the fascia lumborum. Nerves from the lumbar plexus cross it, and the last dorsal nerve lies along the outer edge.

When the muscle acts from the pelvis it can render firm the last rib so as to give a fixed point for the action of the diaphragm in deep inspiration. If both muscles act on the spine they will assist the psoas muscles in maintaining it erect; but if only one is active the spine will be inclined towards the same side. In climbing it will assist the abdominal muscles in raising the pelvis.

The *iliacus muscle*, D, arises from the iliac fossa of the hip-bone, and from the base of the sacrum; from the ilio-vertebral ligament behind; and from the capsule of the hip-joint in front.

* This muscle was found but once in twenty bodies which were examined carefully by Theile. "Lehre von den Muskeln." Leipzig, 1841.

Many of the fibres join internally the tendon of the psoas muscle, but the rest pass beneath Poupart's ligament, and are inserted into the femur in front of and below the small trochanter.

On the right muscle rests the cæcum, and on the left the sigmoid flexure of the colon. Below the pelvis the muscle covers the hip-joint; and as it passes over the anterior edge of the hip-bone, a small bursa lies underneath it.

If the lower limb is free the iliacus assists the psoas in flexing the hip-joint; and if the limb is fixed the muscle will bring forwards the pelvis on the head of the femur.

Lymphatic glands, † †. A chain of glands lies by the side of the large bloodvessels. From these glands small efferent vessels are continued upwards to unite in the thoracic duct (Plate xxxvii.).

BLOODVESSELS OF THE ABDOMEN.

A large arterial, and a venous trunk traverse the abdomen :— the former (aorta) supplies offsets in the cavity, and a large vessel to each limb; the latter (vena cava) formed by the union of two large veins, one from each limb, gathers smaller branches from the abdominal walls and the viscera.

a. Aorta.
b. Common iliac artery.
c. Internal iliac artery.
d. External iliac artery.
e. Diaphragmatic artery.
f. Cœliac axis.
g. Upper mesenteric artery.
h. Renal artery.
i. Spermatic artery.
j. Supra-renal artery.
k. Inferior mesenteric artery.
l. Lumbar arteries.
n. Middle sacral artery.
p. Vena cava inferior.
q. Common iliac vein.
r. External iliac vein.
s. Lowest intercostal artery.
t. Renal vein.
u. Supra-renal vein.
v. Spermatic vein.
w. Lumbar vein.
x. Middle sacral vein.
y. Circumflex iliac artery.

The *aorta*, *a*, the main vessel of the body, extends through the thorax and abdomen. The part in the latter cavity is called abdominal, and reaches from the opening in the diaphragm to the left side of the fourth lumbar vertebra, where it bifurcates into

the common iliac arteries, *b*. This large trunk rests on the vertebral column behind the viscera and the peritoneum, and is crossed by the left renal vein, *t*. Its offsets are visceral and parietal.

The *visceral branches* are the following : three spring from the front of the vessel, viz. cœliac axis *f*, upper mesenteric *g*, and inferior mesenteric *k* ; and three pairs of branches, which come from the sides, are the supra-renal *j*, the renal *h*, and the spermatic *i*. Only the lateral visceral branches remain in the dissection, the former set having been cut necessarily in the removal of the viscera.

The *renal* artery, *h*, is directed almost horizontally outwards to the kidney, and divides near that viscus into branches which enter it between the vein and ureter. The artery of the left side is not so long as that on the right.

The *supra-renal* or middle capsular artery, *j*, taking the same direction as the renal, enters the supra-renal body. In the fœtus it is larger than in the adult.

The *spermatic* artery, *i*, arises near the renal (the testicle deveoping in the loins), and descends over the psoas and the external iliac artery to the internal abdominal ring : at this spot it leaves the abdomen to reach the testicle. On the right side the artery crosses the vena cava.

Originally the spermatic vessels were short and straight, like the renal, but their increase in length is brought about by the testicle passing from the place of growth in the abdomen to the scrotum.

Parietal branches. The arteries that are furnished to the wall of the belly are the diaphragmatic, the lumbar, and the middle sacral.

The *diaphragmatic*, *e*, are the first two branches of the aorta in the abdomen, and ramify on the under surface of the diaphragm. Each courses over the fleshy fibres of the muscle to the front, and furnishes an offset towards the hinder part.

The *lumbar* arteries, *l*, four in number on each side, arise from the back of the aorta, and correspond with the intercostals in the thorax : their distribution is more evident in Plate xxxvii.

The *middle sacral* artery, *n*, arises from the point of splitting of

the aorta, and descending beneath the left common iliac vein, runs along the middle of the sacrum to the end of the spinal column. Small offsets are supplied from it opposite each vertebra.

The *common iliac* artery, *b*, is the primary trunk derived from the bifurcation of the aorta. About two inches in length it reaches as far as the fibro-cartilage between the last lumbar vertebra and the base of the sacrum : at this spot it ends by dividing into external and internal iliac arteries. Of the two vessels the right is more oblique in direction, and longer than the left. Each artery lies against the spinal column, and is placed beneath the peritoneum, like the aorta ; it is crossed by several offsets of the sympathetic nerve, and sometimes by the ureter, P.

On opposite sides of the body the connections with other vessels are different. On the left, the iliac trunk is crossed by part of the inferior mesenteric artery, *k;* and its companion vein, *q*, lies nearer the pelvis. On the right side the iliac artery touches three large venous trunks ; thus the right common iliac vein is external to it, the left common iliac vein crosses beneath it, and the beginning of the vena cava is placed on the outer side opposite the fifth lumbar vertebra.

Only small glandular offsets are furnished, as a rule, by the common iliac trunk, but a renal or an ilio-lumbar artery will take origin from it occasionally.

Ligature.—The length of the arterial trunk, and the origin of branches influence greatly the chances of a successful ligature of it. If the vessel is less than an inch in length it is too short for the application of a thread without hæmorrhage ensuing on the separation of that band ; in such a condition ligature of the beginning of the external and internal iliac would be preferable to tying the trunk that is too short (Quain). If during an operation an uncommon branch should be seen to spring from the iliac artery it should be included in the ligature, in order that its disturbing influence on the obliteration of the vessel may be removed.

Internal iliac artery, c. This is the smallest of the two vessels resulting from the bifurcation of the common iliac trunk : it enters the pelvis, furnishing branches to that cavity, and is shown in Plate xxxvii.

The *external iliac artery*, *d*, courses along the psoas muscle to the lower limb, and reaches from the base of the sacrum to the lower border of Poupart's ligament. Its position will be marked on the surface of the abdomen by a line from the left of the umbilicus to a spot midway between the symphysis pubis and the iliac crest. Throughout its length it is covered by the peritoneum and subperitoneal fat, and a chain of lymphatic glands lies along its side. Near Poupart's ligament it is crossed by several small vessels (p. 290). On the left side the large intestine crosses the artery.

Its companion vein is internal on the left side; but on the right side, the vein is on the inside near Poupart's ligament, and on the outside near the sacrum, crossing under the artery.

Two *branches*, epigastric and circumflex iliac, arise from the artery near the end: they have been noticed before (p. 291). Ligature of the vessel should be practised rather below its middle (p. 290).

Muscular branches in the abdomen. In the diaphragm small terminal offsets of the intercostal arteries ramify, and anastomose with the other arteries to the muscle. To the quadratus, I, and iliacus, L, branches of the lumbar and ilio-lumbar arteries are furnished.

Abdominal veins. Each of the large arterial trunks above described has its companion vein, whose anatomy is similar to that of the artery.

The *external iliac*, *r*, has the same limits as the artery of the same name, and is provided also with two branches, viz. circumflex iliac and epigastric. Its position to the artery varies on the two sides: thus the left lies inside and below, and the right crosses underneath its artery from the inner to the outer side.

The *common iliac*, *q*, is formed by the union of the pelvic vein (internal iliac) and of the lower limb vein (external iliac); the veins of opposite sides blend in the vena cava inferior opposite the last lumbar vertebra, so that the veins do not reach so high as the arteries of the same name. Two veins, ilio-lumbar and lateral

sacral, enter each trunk; and the middle sacral is received into the left common iliac.

The following are the differences between the veins of opposite sides:—In length the left exceeds the right. In position to the companion bloodvessel they vary on the two sides of the body, for instance, the right is external to and above its artery, whilst the left lies below, and passes also beneath the right common iliac artery.

The *inferior cava* (vena cava ascendens) conveys to the heart the blood of the lower half of the body. Placed on the right side of the spine, it begins opposite the body of the fifth lumbar vertebra by the union of the common iliac veins, and passing through the diaphragm enters the right ventricle of the heart: it is therefore longer than its companion artery, the aorta.

Covered in front by the peritoneum like the aorta, it rests for the most part on those branches of the aorta which are directed to the right, viz. lumbar, renal, capsular, and diaphragmatic; but the right spermatic crosses over it. For about an inch and a half from the diaphragm it is surrounded by the liver.

Its branches are parietal and visceral like the offsets of the aorta. The former set, the smallest, consists of lumbar and diaphragmatic.

Visceral veins from the alimentary tube and its glandular viscera, and corresponding with the cœliac axis and mesenteric arteries, do not enter directly the cava, but blend into one—the vena portæ. This single trunk ramifies through the liver; and the circulating blood is finally conveyed to the cava by large veins—venæ cavæ hepaticæ—close to the liver. In the dissection these veins were necessarily cut across by the removal of the liver.

The visceral veins from the supra-renal body, the kidney,* and the testicle, on the right side are received into the cava as separate vessels; but the corresponding veins on the left side join the left renal vein, and the blood from all three is transmitted by this single channel to the cava.

* The right renal vein joins the cava frequently higher than the left: it is also the shortest of the two.

Occasionally the cava lies on the left of the aorta as high as the kidney: then receiving the left renal vein, it crosses the spine into its usual place.

SPINAL NERVES IN THE ABDOMEN.

All the nerves now visible, except two, come from the lumbar plexus in the psoas muscle. In the next Plate the origin of the nerves from the plexus is brought under notice.

1. Last dorsal nerve.
2. Ilio-hypogastric branch.
3. Ilio-inguinal branch.
4. Crural branch of genito-crural nerve.
5. Genital branch of genito-crural.
6. External cutaneous branch.
7. Anterior crural nerve.
8. Ending of phrenic nerve.

Branches of lumbar plexus. The position to the psoas muscle of the branches of the plexus is the following:—Along the outer edge appear four nerves; two at the upper part, viz., the ilio-hypogastric and ilio-inguinal; one about the middle—the external cutaneous; and a large nerve below—the anterior crural. Rather below the pelvic part of the inner edge of the muscle the obturator nerve courses forwards (Plate xxxvii.). Piercing the fibres of the muscle will be one or two pieces of the genito-crural nerve; this difference depending upon the division of the nerve nearer to, or farther from its origin in the plexus.

All these branches are distributed outside the cavity of the abdomen, ending in the abdominal wall, the lower limb, and the cutaneous and fleshy coverings of the spermatic cord.

Ending of the phrenic nerve, 8. Some of the terminal branches of this nerve pierce the fibres of the diaphragm, and run on the under surface of the muscle before disappearing in the fleshy fibres. On the abdominal surface of the muscle they communicate with branches of the sympathetic nerve forming a plexus. At the place of union a ganglion exists on the right side (Swan).

Last dorsal nerve, 1. This trunk appears below the last rib, and enters the wall of the belly to be distributed in it, like the other intercostal nerves: it can be seen more plainly in the following Plate.

DESCRIPTION OF PLATE XXXVII.

THIS Illustration shows the dissection of the lumbar and s plexuses of spinal nerves, and that of the internal iliac artery.

For the preparation of the parts displayed the psoas mu and the veins of the right side of the abdomen were taken aw the external iliac vessels were cut through and removed ; and peritoneum and fat, and the internal iliac vein and its bran were cleared from the pelvis.

DEEP MUSCLES OF THE ABDOMEN.

The muscles now brought into view were referred to in de in the last Plate, but the Quadratus lumborum can be be learnt in this Figure. Only a small part of the diaphragm, has been left ; and the right crus has been cut through to all the beginning of the thoracic duct, and the large azygos vein be seen.

A. Right crus of the diaphragm divided.
B. Left crus of the muscle.
C. Fleshy lateral part of the diaphragm.
D. External arched ligament.
E. Twelfth rib,—right.
F. Quadratus lumborum.
G. Iliacus muscle.
H. Psoas muscle, cut.
I. Ilio-vertebral ligament.
K. Urinary bladder.

ABDOMINAL AND PELVIC ARTERIES.

In this Plate the aorta is represented in outline with the orig of the visceral branches ; and its lumbar offsets are traced ba to their exit from the abdomen. In the cavity of the pelvis t

* Usually the lumbar plexus and the internal iliac artery are dissected opposite sides of the body, but both have been here joined in one view on t right side, so as not to increase unnecessarily the number of Plates.

internal iliac artery and its branches are displayed; and in the aortic opening of the diaphragm the thoracic duct and azygos vein appear.

a. Thoraic duct.
b. Large azygos vein.
c. Aorta.
d. First lumbar artery.
e. Second lumbar.
f. Third lumbar.
g. Fourth lumbar.
h. Last intercostal artery.
i. Middle sacral artery giving a lumbar branch.
k. Common iliac artery.
l. External iliac.
m. Internal iliac.
n. Ilio-lumbar branch.
o. Gluteal artery.
p. Sciatic branch.
r. Pudic branch.
s. Obturator branch.
t. Visceral offsets of the iliac.
v. Lateral sacral branch.

Lumbar arteries, d, e, f, g. Four in number, they belong to the parietal branches of the aorta; but in this body a fifth lumbar springs from the middle sacral artery: they are named first, second, &c., like the vertebræ.

The vessels are directed backwards along the bodies of the vertebræ under the crus of the diaphragm and the psoas, and each divides into two (dorsal and abdominal branches) between the transverse processes. The dorsal branches are continued onwards in the direction of the parent vessel, and supply the back, the contents of the spinal canal, and the vertebræ; the abdominal branches enter the hinder part of the abdominal wall, and anastomose with the intercostal above, and with branches of the internal iliac below.

The veins accompanying the lumbar arteries open into the inferior cava (Plate xxxvi.).

Last intercostal artery, h. Appearing below the last rib with the last dorsal nerve, it pierces the fascia lumborum, and is distributed with its nerve in the wall of the abdomen.

The *internal iliac artery, m,* supplies the pelvic viscera, and maintains anastomoses outside the pelvis with branches of the femoral trunk. It begins opposite the base of the sacrum in the bifurcation of the common iliac artery, *k*, and descends into the pelvis towards the great sacro-sciatic notch, where it divides into two pieces—anterior and posterior. From its extremity a partly obliterated vessel (hypogastric) is continued forwards on the

bladder to the umbilicus in the adult (Plate xxxviii., *d*), but in the fœtus this forms the main channel of the vessel.

Surrounded by much fat the artery measures about one inch and a half in length, and lies commonly on the lumbo-sacral cord and the first sacral nerve. Its companion vein is placed between it and the pelvis, but inclines to the outer part on the right side.

Ligature. The extent of this as of the other iliac arteries is subject to great variations, but its length commonly is from one inch to one inch and a half. Should ligature of the vessel be required during life the length ought to amount to one inch. And should it be found shorter in an operation, say only half an inch, tying both the iliac arteries would be safer than putting a thread on the one (Quain).

Branches of the iliac. These are numerous, and are classified commonly into two sets which come from the two pieces (anterior and posterior) into which the artery divides; but the origin of the branches deviates greatly from the prescribed arrangement. Some of the branches are distributed to the parietes of the pelvis on the inside, some exterior to the cavity, and others to the viscera.

The *internal parietal set* consists of the ilio-lumbar and lateral sacral arteries.

The *ilio-lumbar* branch, *n*, is directed outwards to the iliac fossa beneath the external iliac vessels: there it ramifies in the fossa, some offsets running on the surface of the muscle to the iliac crest, and others supplying the hip-bone. An ascending or lumbar branch anastomoses with the last lumbar artery.

The *lateral sacral* branches are two in number, upper and lower, and the upper is marked with *v*: they run on the side of the sacrum, supplying the pyriformis and coccygeus muscles, and sending branches into the spinal canal through the sacral apertures.

External parietal set. These are the gluteal, sciatic, pudic, and obturator: they are furnished to parts outside the cavity of the pelvis, and anastomose with branches of the femoral artery. Only a short piece of each branch is included in the dissection.

The *gluteal*, *o*, the largest of all, is directed backwards between the sacral nerves to the upper part of the great sacro-sciatic notch: it leaves the pelvis above the pyriformis muscle, and ends in the buttock.

The *sciatic artery*, *p*, descends to the lower part of the great sacro-sciatic notch, and passes from the pelvis below the pyriformis muscle: it ends in the buttock and the back of the thigh.

The *pudic* branch, *r*, takes a downward course with the preceding, and escapes from the pelvis between the pyriformis and coccygeus muscles: its distribution is exhibited in the Plates of the Perinæum.

The *obturator* artery, *s*, runs forwards across the pelvic cavity with the nerve of the same name to the sub-pubic foramen: external to the pelvis it supplies the obturator muscle and the hip-joint.

Visceral branches. In both sexes there are vesical and hæmorrhoidal arteries; and in the female there are in addition uterine and vaginal.

The *vesical branches*, *t*, three in number, come from the iliac, and the partly obliterated hypogastric artery (Plate xl.), and ramify in the upper and lower regions of the bladder.

The *middle hæmorrhoidal* artery arises most often in common with the lower vesical: it is small, and is distributed in the rectum.

Uterine and *vaginal* arteries. These branches, which are special to the female, are distributed as the names signify. The uterine is the larger and is tortuous; and the vaginal is generally an offset of the middle hæmorrhoidal.

The *large azygos vein*, *b*, begins in a lumbar vein, and may communicate with the inferior cava. It enters the thorax through the aortic opening, receives most of the intercostal veins of both sides, and ends in the vena cava superior.

Thoracic duct, *a*. Opposite the last dorsal, or the first lumbar vertebra this tube begins in a dilatation—receptaculum chyli, between the aorta and the right crus of the diaphragm. Into this dilated part three or four large lymphatic vessels from the mesenteric and lumbar glands are received. It ascends then through

the thorax, and ends in the neck by joining the left subclavian vein.

The *ilio-vertebral ligament* I, stretches between the transverse process of the last lumbar vertebra and the iliac crest of the hip-bone, opposite the hinder part of the iliac fossa: from the upper and posterior part the quadratus lumborum P takes origin, and from the front, the iliacus.

SPINAL NERVES IN THE ABDOMEN.

The anterior primary branches of the lumbar and sacral nerves are united into a large plexus along the side of the spinal column. After this union several branches are distributed to the limb; the crural offsets from the upper part belong to the front of the limb, and those from the lower part of the plexus enter the back of the thigh.

1. First lumbar nerve.
2. Second lumbar.
3. Third lumbar.
4. Fourth lumbar.
5. Fifth lumbar.
6. Ilio-hypogastric branch.
7. Ilio-inguinal branch.
8. Genito-crural branch.
9. External cutaneous.
10. Anterior crural.
11. Obturator nerve.
12. First sacral nerve.
13. Second sacral.
14. Third sacral.
15. Fourth sacral.
16. Superior gluteal branch.
17. Last dorsal nerve.
23. Branch to lumbo-sacral.
24. Lumbo-sacral cord.
25. Sacral plexus.

The *lumbar nerves* are five in number, and are marked 1, 2, 3, &c. They increase rapidly in size from first to last; and they communicate with each other, and with the knotted cord of the sympathetic, as soon as they escape from the intervertebral foramina. Small muscular offsets are furnished by the nerves to the psoas and quadratus.

Four of the nerves unite in the lumbar plexus, whilst the last or fifth enters the sacral plexus. Sometimes too the first lumbar is joined to the last dorsal by a small branch (dorsi-lumbar).

The *lumbar plexus* is formed by the intercommunication of the four highest nerves; and it is embedded in the large psoas muscle. Below, it is connected with the sacral plexus through the lumbo-

sacral cord. Its offsets, six in number, are furnished to the lower part of the abdominal wall, to the spermatic cord coverings, and to the front of the limb.

Ilio-hypogastric, 6, and *ilio-inguinal*, 7: these two branches arise in the first nerve, and come into sight at the top of the psoas muscle. Directed downwards and outwards across the quadratus lumborum to the iliac crest, they enter the wall of the belly, and end in the muscles and integuments (Plate xxx., p. 269). At the iliac crest the nerve, 6, gives a cutaneous offset to the buttock.

Genito-crural, 8. This branch comes from the second nerve, and the loop between the first two. Piercing the fibres of the psoas, it descends on the surface of that muscle towards Poupart's ligament, and divides into two.

The genital part, which is cut, leaves the abdomen with the spermatic vessels and is distributed to the cremaster muscle.

The crural piece is continued below the ligament, and reaches the teguments of the front of the thigh.

The *external cutaneous*, 9, springs in the third nerve, and appears at the outer border of the psoas about the middle: the nerve leaves the belly beneath the outer end of Poupart's ligament, and ramifies in the teguments of the outer part of the thigh.

The *anterior crural* nerve, 10, is the largest offset of the plexus: it receives most of the fourth nerve, and is joined by a large fasciculus from the nerves above. Emerging from beneath the psoas near Poupart's ligament, it lies in the hollow between that muscle and the iliacus. The nerve escapes from the abdomen beneath Poupart's ligament, and is supplied to the fore part of the limb.

In the abdomen it furnishes two or more branches to the iliacus muscle, and a small nerve to the coats of the femoral artery.

Obturator nerve, 11. Beginning in the third and fourth nerves, it comes into sight at the pelvic border of the psoas. It is then continued across the cavity of the pelvis to the sub-pubic aperture in the upper part of the thyroid foramen, and terminates in the adductor muscles of the thigh.

The *lumbo-sacral* cord, 24, is formed by the whole of the fifth lumbar nerve, and by a fasciculus, 23, which is derived from the fourth nerve. This large nerve enters the sacral plexus in the

pelvis, and serves as the connecting cord between this and the lumbar plexus.

Before the cord joins the first sacral nerve it gives origin to the *upper gluteal* nerve, 16; this branch passes out of the pelvis through the upper part of the great sacro-sciatic notch with the gluteal artery, and is distributed to muscles on the back of the pelvis.

Sacral nerves. Five in number like the lumbar nerves, they decrease in size from above down. Four of them issue from the spinal canal through the apertures in the front of the sacrum, and the fifth or last comes between the sacrum and the coccyx. The three highest and part of the fourth enter the sacral plexus; but the rest of the fourth joins the fifth nerve, and terminates in muscular and visceral branches. The fifth sacral nerve joins the coccygeal, and ends on the back of the coccyx.

The *sacral plexus*, 25, is formed chiefly by the union of the three upper sacral nerves with part of the fourth, as before said; and it is further joined by the large lumbo-sacral cord, 24, from above. Its component nerves blend together in a flat band which rests on the pyriformis muscle.

Its branches are numerous:—Some belong to the external rotator muscles, and will be dissected with the buttock; others are prolonged to the back of the limb; and one is distributed to the perinæum.

Last dorsal nerve, 17. This lies below the last rib, and appears in the abdomen after passing through or beneath the external arched ligament, with its accompanying artery. After a distance of three inches about, it pierces the posterior tendon of the transversalis muscle (fascia lumborum), and terminates in the abdominal wall. A separate small abdominal branch arises from the nerve before this leaves the abdomen.

KNOTTED CORD OF THE SYMPATHETIC.

In the abdomen the sympathetic consists of plexuses in front of the vertebral column, for the supply of the viscera; and of two gangliated cords, one on each side of the spine, which join the

different spinal nerves. As the viscera have been removed from the abdomen only the knotted cords remain.

18. Great splanchnic nerve.
19. Small splanchnic.
20. Smallest splanchnic.
21. Lumbar part of the gangliated cord.
22. Sacral part of the cord.

The *lumbar part* of the gangliated cord, 21, lies along the inner border of the psoas muscle, and is covered on the right side by the vena cava inferior. A ganglion exists, for the most part, opposite each vertebra; and from it offsets are prolonged internally and externally.

The *external branches*, two in number from each ganglion, join generally two spinal nerves.

The *internal branches* are directed over the aorta and terminate in the large visceral plexuses.

The *sacral part* of the cord, 22, rests on the front of the sacrum internal to the row of apertures. Below, the cords of opposite sides are connected by a loop in front of the coccyx, on which there is situate a single median ganglion—the "ganglion impar." The number of the ganglia is oftentimes less than that of the vertebræ; and those bodies are smaller in the pelvis than elsewhere. External and internal offsets are given from these as from the lumbar ganglia.

External branches, two in number, enter either one or two spinal nerves.

Internal or *visceral branches*, small in size, are prolonged from the first two ganglia to the centre in front of the sacrum, called the hypogastric plexus; the branches from the remaining ganglia ramify on the front of the sacrum, and form a plexus on the middle sacral artery.

Splanchnic nerves. These are three in number on each side, and take origin in the ganglia of the knotted cord of the sympathetic in the thorax. They are named large, small, and smallest, and pierce the fibres of the crus of the diaphragm.

The large splanchnic, 10, ends in one of the ganglia (semilunar), forming part of the solar plexus in the abdomen.

The small splanchnic, 19, terminates near the preceding in the lateral part of the solar plexus.

The smallest splanchnic, or renal nerve, 20, throws itself chiefly into the plexus for the kidney, and joins the solar plexus.

DESCRIPTION OF PLATE XXXVIII.

FIRST view of the dissection of the pelvis, to illustrate the anatomy of the muscles closing the pelvic outlet.

For this side-view the left limb was removed by sawing through the hip-bone near the symphysis pubis in front, and near the articulation with the sacrum behind, the muscles of the abdominal wall having been previously divided by a cut from the one sawn part of the pelvis to the other. After forcibly separating the hip-bone the pelvic fascia was detached, and the ischial spine was cut off with a bone forceps, and thrown down with its muscles.

A large quantity of fat will need removal from the perinæal surface of the levator ani; from the pudic artery and nerve lying against that muscle; from the viscera in the pelvis; and from the branches of the internal iliac artery and the sacral plexus.

MUSCLES CLOSING THE PELVIC OUTLET.

Three muscles, viz., levator ani, coccygeus, and pyriformis, close on each side the elongated interval between the ilio-sacral articulation and the symphysis pubis. Other muscles of the abdominal wall, loins, and buttock, are shown cut through in the Figure.

A. External oblique muscle.
B. Internal oblique, and the transversalis.
C. Psoas magnus muscle.
D. Iliacus muscle.
E. The rectum or large intestine.
F. Bag of the peritoneum.
G. Vas deferens of the testis.
H. Urinary bladder.
I. Spermatic cord.
J. Ureter from the kidney.
K. Crus penis, cut through.
L. Anterior layer } of triangular
N. Posterior layer } ligament.
O. Ejaculator urinæ muscle.
P. Levator ani muscle.
Q. Ischial spine, cut off.
R. Coccygeus muscle.
S. Sphincter ani externus.
T. Gluteus maximus muscle.
V. Pyriformis muscle.
W. Hip-bone, cut.

The *pyriformis* muscle, V, arises by fleshy slips from the bodies of three sacral vertebræ (the first and last bones being free); from the lateral mass of the sacrum outside the anterior foramina; and from the upper part of the posterior border of the hip-bone. Leaving the pelvis by the great sacro-sciatic notch, it crosses the back of the hip-joint to be inserted into the top of the great trochanter. See Plate of the Buttock.

In the pelvis the muscle lies beneath the sacral plexus, and some branches of the internal iliac artery; and on the left side the rectum rests on it. As it passes through the great sacro-sciatic notch it divides that space into two. In contact with the lower border is the coccygeus.

The *coccygeus* muscle, R, thin and triangular in shape, arises from the upper edge and the point of the ischial spine, Q, of the hip-bone; and it is inserted by a widened part into the front of the coccyx near the edge, and into the last piece of the sacrum.

Intermediate in position between the levator ani and the pyriformis, the muscle blends by its lower edge with the levator, and is separated from the pyriformis by the pudic and sciatic vessels and nerves. The pelvic surface touches the rectum, and the perinæal surface blends with the small sacro-sciatic ligament which partly conceals it: the muscle is crossed by the pudic nerve and artery when these are displaced by the dissection.

The muscles of opposite sides support the pelvic viscera and the coccyx; and shortening by the contraction of the fibres, they will draw forwards the coccyx after the bone has been forced backwards.

Levator ani, P. The insertion of the muscle is shown in Plate xxx., and the origin appears in this side-view of the pelvis.

It arises in front from the back of the pubes just above the obturator internus, lower down from the fascia covering the obturator muscle, and, still lower, from the back of the triangular ligament, N; behind, from the lower border of the ischial spine, Q; and between those osseous attachments, from the under surface of the recto-vesical fascia. Its fibres are inclined down and back, and have the undermentioned insertion;—the most anterior unite below the triangular ligament with the muscle of the other side at

the central point of the perinæum; others course backwards over the side of the gut, some joining the muscular coat of the intestine, to meet in a tendinous line, between the gut and the coccyx, the fibres of the opposite muscle; and the posterior fibres end on the lower part of the coccyx.

By their position in the pelvic outlet the muscles form a fleshy diaphragm, which is convex to the perinæum and is pierced by the rectum. The outer surface looks to the wall of the pelvis and the ischio-rectal fossa, and the inner, to the bladder and urethra, and the rectum. The anterior border lies against the urethral tube in the male, and the urethra and vagina in the female; whilst the interval between the muscles of opposite sides is closed by the triangular ligament of the urethra.

When the levator ani contracts it raises the rectum; and it will restore to the natural position the lower end of the intestine which has been protruded, and everted in the passing of the feces. It will also compress the lower part of the bladder, and the generative organs lying below and in front of that viscus. And as the muscles of opposite sides unite below the urethral tube in the male, and the vagina in the female, they will be able to constrict those passages. By means of the fibres attached to the coccyx the muscles will raise that bone with the aid of the coccygeus.

The *triangular ligament* of the urethra is described in p. 256. In this figure the two layers are represented as they appear after the removal of the bone to which they are attached on the side. The two strata of which it consists are farther apart in the middle line than on the sides, and between them lie muscles, vessels, and nerves. Inferiorly, the layers blend together; and from the lower edge a thin fascia is prolonged over the levator ani muscle in the ischio-rectal fossa. In this view the posterior layer is seen to be pierced by the dorsal artery and nerve of the pudic; and to give attachment to the levator ani, P.

INTERNAL ILIAC ARTERY.

Visceral branches, and the obliterated hypogastric, are continued forwards from the end of the internal iliac; and these, with the

pudic artery, are the chief vessels in the Figure. The other arteries, which are cut through, do not require further notice than that contained in the table of reference.

a. Common iliac artery.
b. Common iliac vein.
c. Superior vesical artery.
d. Obliterated hypogastric.
e. Middle vesical artery.
f. Inferior vesical artery.
g. Pudic artery.
h. Inferior hæmorrhoidal branch.
i. Superficial perinæal branch.
j. *k.* } Dorsal artery of the penis.
l. Artery of the bulb.
n. Spermatic artery.
o. Spermatic veins.
p. Sciatic artery, cut.
r. Branch of the sciatic.

Obliterated hypogastric. In the fœtus the artery in the place of the internal iliac is continued through the umbilicus to the placenta. This vessel is called hypogastric as it lies by the side of the bladder and within the belly, and umbilical outside that cavity. After birth that artery is obliterated, and the cord above noticed remains in its place.

This cord, *d*, is placed in the adult on the lateral part of the bladder as far as the apex, and then against the abdominal wall as high as the umbilicus. By its side lies a small artery which furnishes vesical offsets.

Vesical arteries. Two or three in number, they spring from the fore part of the internal iliac trunk: the upper and middle, *c* and *e*, supply the greater part of the bladder, whilst the lower, *f*, is distributed to the base and the generative parts below.

Pudic artery, g. In the views of the perinæum this vessel has been exhibited in parts, but in this side-view it is laid bare from the beginning nearly to the end. It leaves the pelvis through the lower part of the great sacro-sciatic notch, and winding over the back of the ischial spine, appears in the ischio-rectal hollow of the perinæum by passing through the small sacro-sciatic notch. Entering next between the layers of the triangular ligament by perforating the posterior, N, near the base, it finally pierces the anterior layer near the symphysis pubis (Plate xxx.), and ends in the penis.

Its named *offsets* are furnished chiefly to the lower end of the rectum, to the perinæum and scrotum, and to the urethra and the penis: they are numerous, and arise from behind forwards as here

stated:—Inferior hæmorrhoidal, *h*, one or two in number; superficial perinæal, *i*; artery of the bulb, *l*; dorsal artery of the penis, *j*; and muscular to the levator ani and the perinæal muscles. For the detailed description of these branches, see the Perinæum.

The *sciatic* artery, *p*, which is seen to descend through the pelvis in Plate xxxvi., escapes from that cavity below the pyriformis, V, lying between this and the coccygeus, R.

PUDIC NERVE AND BRANCHES.

The distribution of this nerve is displayed in the Plates of the Perinæum, but its origin, general course, and branching, appear in this view.

1. Sacral plexus.
2. Dorsal nerve of the penis.
3. Perinæal nerve.
4. Inferior hæmorrhoidal branch.
5. Superficial perinæal branches.
6. Branch to ejaculator urinæ.
7. Branch to constrictor urethræ.

The *pudic nerve* arises in the sacral plexus as one or two pieces, and has the same general course and distribution as the artery of the same name. Where it begins as a single trunk the parts, 2 and 3, are blended as far as the ischial spine, Q; but at this point they separate, one, inferior, reaching the perinæum, and the other, superior in position, being furnished to the penis.

The *perinæal* branch, 3, is directed forwards to the scrotum in which it ends; its offsets are these:—One or two inferior hæmorrhoidal branches, 4, to the muscles and integuments of the lower end of the rectum; two superficial perinæal branches, 5, (anterior and posterior) to the integuments of the scrotum; and branches to the muscles, and the part of the urethra in the perinæum, of which two, 6 and 7, are shown.

The *dorsal nerve* of the penis, 2, ascends along the side of the pelvis and the internal obturator muscle to the back of the triangular ligament; and takes its place between the layers of that membrane by penetrating the posterior layer higher than the dorsal artery of the penis. In company with the artery of the same name it ascends near to the symphysis pubis, perforates the anterior layer of the ligament, and is distributed to the body and the integuments of the penis.

DESCRIPTION OF PLATE XXXIX.

THE arrangement of the recto-vesical fascia is set forth in this second view of the dissection of the pelvis.

After dividing the levator ani near its origin, and throwing down that muscle, the recto-vesical fascia will become apparent. To demonstrate the existence of sheaths of the membrane on the prostate and the rectum, incisions may be made in a longtitudinal direction into the fascia on those viscera, as in the Figure.

RECTO-VESICAL FASCIA.

This membrane is attached to the viscera, assisting to support them, and forms a partition between the pelvis and the perinæum.

The same letters of reference for the same parts are used in this and the preceding Figure.

A. Recto-vesical fascia.
B. Line of attachment to the viscera.
C. Sheath on the prostate.
D. Sheath for the rectum.
E. Upper part of the rectum.
F. Bag of the peritoneum.
G. Vas deferens of the testis.
H. Urinary bladder.
I. Spermatic cord.
J. Ureter from the kidney.
K. Crus penis, cut.
L. Prostate.
N. Triangular ligament.
O. Ejaculator urinæ.
P. Levator ani, thrown down.
Q. Ischial spine, cut off.
R. Coccygeus muscle.
S. Rectum, lower part.

The *recto-vesical fascia*, A, is an offset of the layer lining the obturator muscle on the wall of the pelvis. Before the hip-bone is detached, a whitish line, reaching from the front of the pelvic cavity to the ischial spine, marks the beginning of this fascia. From this origin the membrane is directed inwards obliquely on the levator ani; and meeting with a similar piece on the opposite side, forms a septum between the cavity of the pelvis and the

perinæum. This septum is rather convex below, and is pierced by the lower part of the bladder and the rectum, so that the viscera are partly within the cavity of the abdomen, and partly outside the flooring or membranous boundary of that cavity. Though the viscera pass through the fascia there is not any passage leading from the pelvic cavity, for the margins of the apertures for their transmission are inseparably united to the parts transmitted. From the under or perinæal surface of the fascia are furnished two prolongations, like the fingers of a glove, which form sheaths for the prostate and the rectum.

As the fascia suspends the bladder, it forms the true ligaments of this viscus on each side, and in front. These will be noticed below.

The *sheath of the prostate*, C, derived from the recto-vesical fascia, as above said, blends at the front of that body with the posterior layer, N, of the triangular ligament. It gives a complete, though not very dense covering, and is separated from the prostate by a plexus of veins, and by some small arteries.

Sheath of the rectum. This incases about the lower four inches of the gut, and is continued to the anus where it gradually ends. It is thicker than the tube on the prostate, and is separated from the intestine by fat, and by the upper hæmorrhoidal vessels.

Ligaments of the bladder. The part of the fascia intervening between the wall of the pelvis and the bladder constitutes, as before said, the true ligaments of that viscus: they are two in number on each side, anterior and lateral, but there is not any separation between them.

The *anterior*, T, is a narrow prominent band which reaches from the back of the pubes to the sheath of the prostate and the neck of the bladder. It contains a bundle of muscular fibres derived from the external or longitudinal layer of the urinary bladder. A hollow exists between the ligaments of opposite sides.

The *lateral ligament* is the wide expanded part of the fascia, A, which is attached to the neck and the side of the bladder above the vesicula seminalis, along the line, B. From its insertion a piece is continued under the bladder to incase, with a like piece from the opposite side, the vesicula seminalis in a sheath.

Ligament of the rectum?. No name has been given to the part of the fascia which is attached to the gut; but from the ischial spine the membrane is continued to the intestine, and this part might be called the lateral ligament of the rectum, from its supporting that viscus.

From the arrangement of the recto-vesical fascia on the viscera it appears that the prostate, and the lower part of the rectum lie below the septum or the membranous flooring of the abdomen, and may be reached from the perinæum without entering that cavity. About a finger's length of the intestine may be cut without passing the limits of the fascia; and all the prostate may be cut through in a direction downwards and backwards without injuring the septum. The reflection of the fascia with respect to the prostate demonstrates how division of this body can be made for the extraction of a stone from the bladder without entering the abdomen; and its disposition on the rectum will explain how the intestine may be slit in the operation for fistula in ano without serious consequences ensuing.

The attachment of the fascia to the side of the bladder indicates in what direction a cut is to be made in that viscus for the extraction of a calculus in the adult, which is larger than the prostate, or even of a stone of moderate size in the child. An incision carried downwards and backwards below the attachment, B, of the fascia, but parallel and close to it, would divide the viscus along the upper edge of the vesicula seminalis, and would be made below the septal piece, A, and therefore below the cavity of the abdomen. In the case of such a cut being practised the urine would flow down to the perinæum, because the barrier presented by the septal part of the fascia would stop its progress in the opposite direction. Should however an incision be made upwards, in a direction towards the apex of the bladder, the knife would divide the septal piece of the fascia, and open up the cavity of the abdomen.

Vessels and nerves. Some of the arteries to the viscera, and a part of the sacral plexus are shown in this and the preceding Plate; but they will be noticed in the description of the next

Plate. The letters of reference by which they are marked are the same, for the most part, in all the Figures of the side-view of the pelvis.

a. Common iliac artery.
b. Common iliac vein.
d. Obliterated hypogastric.
f. Inferior vesical.
g. Branches of upper hæmorrhoidal.
h. Artery to levator ani, cut.
i. Dorsal artery of the penis.
l. Prostatic artery.
n. Spermatic artery.
o. Spermatic veins.
p. Sciatic artery.
†† Nerve to levator ani, cut through.

DESCRIPTION OF PLATE XL.

THE connections of the viscera of the male are given in this last side-view of the pelvis.

On removing the pelvic fascia, the areolar tissue and the fat, the viscera will appear as they are represented in this Plate. The bag of the peritoneum should be left unopened.

CONNECTIONS OF THE VISCERA.

The two large viscera in the male pelvis are the urinary bladder and the rectum. And connected with the under surface of the bladder are some accessory parts of the generative apparatus, viz., the vesiculæ seminales with the vasa deferentia, and the prostate.

A. Anterior true ligament of the bladder.
B. Vesicula seminalis.
C. Lower part } of the rectum.
D. Middle part }
E. Upper part }
F. Pouch of the peritoneum.
G. Vas deferens.
H. Urinary bladder.
J. Ureter.
K. Crus penis, cut.
L. Prostate.
N. Triangular ligament.
P. Levator ani, cut.
R. Coccygeus.
S. Sphincter ani externus.

The *rectum*, or the lower part of the large intestine, begins opposite the articulation of the left hip-bone with the sacrum, and ends at the anus. Between those points it takes a bent

course behind and below the bladder, and lies in the curve of the sacrum and coccyx. It measures about eight inches in length, and is divided into three parts.

The upper part, E, extends to the third piece of the sacrum: it is inclined inwards to the mid-line of that bone, and it is surrounded by the peritoneum which attaches it to the pelvic wall by a fold—the meso-rectum. Branches of the left internal iliac artery, and the left ureter, are directed forwards by the side of the gut.

The middle portion, D, reaches to the end of the coccyx and the coccygeus muscle. It is about three inches long; and it is invested by the peritoneal pouch, F, which tapering gradually to a point, covers the sides and front of the intestine above, but only the fore part below. Resting behind on the sacrum and coccyx, it touches in front the under part of the bladder with the vesiculæ seminales and the vasa deferentia. On each side descends the coccygeus, R.

The third piece, C, intervenes between the tip of the coccyx, and the anus; it measures about one inch and a half, and is curved backwards somewhat. It is destitute of serous membrane. Above are the prostate, and the membranous part of the urethra between the layers of the triangular ligament. It is incased by muscles;—the lavatores ani of opposite sides covering and supporting it on the sides and behind, and the external sphincters surrounding it at the anus. Its size is narrow at the orifice on the surface; but above that point is a dilatation, which is greatly enlarged in old men so as to rise upwards on the sides of the prostate, and in which the fæces accumulate.

By the introduction of the finger into the rectum the size, and condition of the prostate may be ascertained; and by the same means assistance may be given sometimes in the recognition of a calculus in the bladder, for the finger can raise and bring within reach of the sound the stone that has fallen into the hollow of the bladder behind the prostate.

In the operation of puncturing the bladder through the rectum for retention of urine, a bent canula with a trocar is passed into the gut, and is guided by the fore finger to the under part of the

bladder which is to be punctured, viz., the base between the vesiculæ seminales, and behind the prostate. But the instrument should not be introduced farther than three inches from the anus, lest the pouch, F, of the peritoneum should be injured.

As the arteries *j*, *k*, *l*, &c., which are directed longitudinally on the exterior, pierce the intestine and take a straight course inside to the anus, they will be best avoided in an operation by cutting parallel to them. The arrangement of these arteries lower down in the gut will be referred to after.

The *urinary bladder*, H, receives the urine conveyed by the ureters, and assists through the action of its muscular wall in the expulsion of that fluid from the body. It is placed at the front of the pelvis, above the rectum, and is partly surrounded by peritoneum, which helps to retain it in sitû.

Its form is determined by its degree of distension. When empty it is flattened, and is triangular in shape; but as it becomes distended it assumes a conical form, with the apex towards the abdominal wall and the base to the rectum. Its height in the abdomen varies with the degree of dilatation; for it lies below the brim of the pelvis in the contracted state, but as it expands it rises above the pelvis against the abdominal wall; and in extreme distension it is curved forwards over the pubes by the resistance opposed by the small intestines to its ascent.

When moderately dilated it measures about five inches in length, and three in diameter, and holds about a pint; but it is larger in the female than the male. Parts of it have received the following designations:—The upper end is named apex, and the lower, the base; the intervening portion is the body; and the term neck is given to the part surrounded by the prostate.

Connections of the bladder:—The apex touches the pubes, or the abdominal wall according to the distension. From it three cords are continued to the umbilicus, viz., the obliterated hypogastric artery on each side, and the urachus in the middle. Behind the vessels the bladder is covered by the peritoneum, but is free from that membrane in front of them.

The base or fundus rests on the middle piece of the rectum without the intervention of peritoneum. In contact with it on

each side is the vesicula seminalis with the vas deferens; and the part between those bodies is called the triangular space of the bladder. The size of the base and its shape depend upon the distension; for as the bladder increases in size it projects towards the rectum, and forms a pouch below the level of the cervix and the canal of the urethra, into which a calculus will subside.

The body of the viscus touches in front the wall of the pelvis, and is free from peritoneum; and when the bladder is distended it rises above the pelvis, and can be reached by an incision through the lower part of the abdominal wall, without injury to the serous membrane. Behind, it is covered by the peritoneum, and is in contact more or less with the small intestines, which descend into the pelvis in some bodies. Laterally the obliterated hypogastric artery ascends along the viscus; and descending behind this is the vas deferens, which passes internal to the ureter and the vesicula seminalis. Nearer the fundus the ureter pierces the muscular wall. All the side behind the obliterated hypogastric is clothed by the peritoneum, whilst all in front of it is devoid of that layer; so that the cord of the obliterated vessel lies along the line of reflection of the serous membrane.

The neck or cervix is the narrowed part of the bladder which is surrounded by the prostate; and from it the urethra or the excretory canal of the urine is continued. In the contracted state of the viscus it is the lowest part of the cavity, but in distension it is placed considerably above the fundus.

The *ureter*, J, brings the urine from the kidney to the bladder. Crossing the common iliac vessels, it is continued through the pelvis to the bladder; and it pierces this, below, at the lateral aspect, and about one inch and a half from the prostate. In the pelvic cavity it forms an arch below that of the obliterated hypogastric artery.

Ligaments of the bladder. This viscus is retained in place partly by ligaments: of these there are two kinds, true and false.

The *true* ligaments consist of the pelvic fascia: they are attached to the neck and the lower part of the bladder, and are noticed with the preceding Plate (p. 318).

The *false* ligaments are formed by the peritoneum: they are

five in number, viz., two posterior, two lateral, and one superior. They are parts of a wide piece of peritoneum, reaching from the side of the bladder to the abdominal wall, which is subdivided arbitrarily into the parts above said.

The upper, which is single, is directed from the apex along the obliterated hypogastric artery.

The lateral, one on each side, is attached to the viscus behind the obliterated hypogastric.

The posterior, also one on each side, is produced by the part of the hypogastric vessel behind the back of the bladder. It consists of a doubling of the serous membrane, and contains the remains of the obliterated vessel, the ureter, and some vesical arteries. Between the ligaments of opposite sides the serous membrane extends downwards as the recto-vesical pouch.

The *recto-vesical pouch*, F, is the piece of the peritoneum which sinks between the bladder and the rectum; it receives its name from its position. Behind, it is as wide as the interval between the posterior ligaments of the bladder, but in front it tapers to a point, and projects slightly between the vesiculæ seminales. Its fore part is distant about four inches from the anus. In puncturing the bladder through the rectum, the surgeon should be careful not to carry his instrument so far back as to injure the pouch, because in that case the urine would find its way into the cavity of the abdomen, and would give rise to peritonitis. But the distension of the bladder affords some security against this accident; for as the viscus enlarges it carries upwards the peritoneum, and removes the pouch farther from the anus.

Generative apparatus. In the pelvis are contained the following accessory generative parts, viz. the vesicula seminalis and vas deferens, together with the prostate.

The *vas deferens*, G, is the excretory duct of the testicle, and conveys the semen to the urethra. Separating from the vessels of the spermatic cord at the internal abdominal ring, it crosses the obliterated hypogastric artery, and then descends along the side, to the under part of the bladder, where it joins with the vesicula seminalis to form the common ejaculatory duct: finally it ends

in the prostatic part of the urethra. At the under surface of the bladder it is placed internal to the vesicula seminalis of the same side, and is enlarged and slightly sacculated.

The *vesicula seminalis*, B, one on each side, is a small sacculated reservoir below the bladder, which is connected with the vas deferens, like the gall bladder with the biliary duct. Rather larger behind than in front it is covered by a layer of the recto-vesical fascia, and of involuntary muscular fibres; and it forms with the vas deferens the lateral boundary of the triangular space at the fundus of the urinary bladder. It is filled with a fluid secreted by itself, and contains some semen brought by the vas deferens.

It is constructed of a tube bent into a zigzag form; and on removing the surrounding fibrous tissue the bends disappear, and the tube measures from four to six inches. In front it becomes narrowed, and joins the vas deferens at the back of the prostate to give rise to the common ejaculatory duct.

The *prostate* gland, L, surrounds the neck of the bladder, and the beginning of the urethra, and is a firm muscular and glandular body.

Shaped like a chestnut with the larger end backwards, it measures one inch and a quarter from before back, one inch and a half across at the base, and about three quarters of an inch in depth. Its upper surface is convex, and the under is flattened; and it is described as consisting of a median and two lateral lobes.

Situate between the triangular ligament of the urethra and the bladder it is placed about an inch below the pubes, and is incased in a sheath, as before said. Its upper surface is connected to the pubes by the recto-vesical fascia forming the anterior true ligament of the bladder; and the under surface touches the rectum. The apex is in contact with the triangular ligament of the urethra, and the base surrounds the neck of the bladder. Through this body the urethra is directed forwards from the bladder, rather above the centre; and the two common ejaculatory ducts are inclined obliquely upwards in it to open into the urethra.

A line through the centre of the prostate has a different direc-

tion in the standing and recumbent postures. In the erect position of the body it curves upwards and backwards from the triangular ligament; but when the body is recumbent, as in the operation for stone, the axis is inclined downwards and backwards from that membrane. This change in the axis is to be kept in mind in lithotomy, because the knife is to be directed in that line into the bladder.

The prostate is made up of involuntary muscular fibres which are chiefly circular. Surrounding the fibres externally is a thin membrane or rind, which is quite distinct from the sheath derived from the recto-vesical fascia (p. 318).

Some glands are placed below the urethral tube, projecting amongst the muscular fibres: they open into the floor of the urethra by twelve to twenty ducts. The secretion of these glands is poured into the urethra, and is added to the seminal fluid obtained from the testicle and the vesicula seminalis.

Curve of the urethra. The bend in the hinder part of the tube of the urethra below the symphysis pubis constitutes the permanent curve. It reaches from the bladder to about an inch and a half in front of the triangular ligament. Its convexity is turned towards the perinæum and the rectum, and is greatest at the front of the triangular ligament in the erect position of the body. From this point it is inclined upwards and forwards to the penis, and upwards and backwards to the bladder.

The urethral tube is kept in place by its union with the penis, by its passage through the triangular ligament, and by the recto-vesical fascia around the prostate. It is surrounded completely by muscular fibre, in part voluntary, and in part involuntary:— Thus in front of the triangular ligament it is incased by the ejaculator urinæ—a voluntary muscle; between the layers of that structure the voluntary constrictor urethræ, with a thin involuntary stratum, surrounds the tube; and behind that ligament the urethra is included in the thick involuntary mass of the prostate.

In the passage of a catheter or sound along the urethra the greatest hindrance is met with in the urethral curve, and especially where this passes through the anterior layer of the trian-

gular ligament; for immediately before that membrane the urinary passage is dilated in the sinus of the bulb, and will permit the point of the instrument to deviate from the straight line, even when it is of the proper size. Beyond the ligament, obstruction to the progress of the instrument can scarcely exist in consequence of the large capacity of the urethra.

The third stage of the lateral operation for lithotomy consists in dividing the part of the urethral curve behind the triangular ligament. The knife having opened the urethra between the layers of the triangular ligament (p. 260) is carried into the bladder through the prostate. To give the necessary direction to the incision the handle of the knife is to be raised above the level of the blade, and the edge is to be turned down and out. The lateral part of the prostate is to be incised, so as to obtain the greatest opening in that body; and more or less of the neck of the bladder is to be cut through according to the size of the calculus. In the division of those parts the heel of the scalpel is to be kept near the staff, whilst the fore part of the blade is used with a sawing motion. If the stone is larger than can be removed by the incision on one side, a similar cut is to be practised in the opposite half of the prostate.

In executing this third stage of the operation the surgeon endeavours to cut as little as possible of the loose sheath of fascia enveloping the base of the prostate and the neck of the bladder, in order that the piece of the recto-vesical fascia separating the pelvic cavity from the perinæum may remain intact. This object will be attained most certainly by keeping the heel of the knife near the staff as above directed; for if the hinder part of the blade is too far removed from that instrument the aperture into the bladder will be necessarily larger, and the prostate and its sheath may be totally divided. It is just possible also, if the prostate is slit too largely, that the "accessory pudic" artery, (Quain), which lies occasionally on the side of the prostate, may be wounded with fatal result.

Where it is necessary to augment still more the opening for the extraction of a large calculus, or one of moderate size in a child, the bladder may be cut in the same line as the prostate, viz. as

nearly as possible along the upper edge of the vesicula seminalis and below the attachment of the lateral ligament of the recto-vesical fascia. To me it appears safer to cut that viscus in a direction the most desirable, than to leave it to tear in a less favourable direction under the influence of the force used, as it is said, for the dilatation of the prostate.

Stricture of the urethra is most common at the fore part of the curve where the tube is covered by the ejaculator urinæ muscle; it has its seat but seldom in the membranous part, and is rare in the prostatic part of the canal.

In rupture of any part of the urethral curve the urine will find its way to the scrotum and penis. If the accident is situated at the fore part, in front of the triangular ligament, the fluid will be confined and directed forwards by the superficial fascia (p. 250). If the urine escapes between the layers of the ligament, it will move forwards in consequence of the anterior layer of that structure being less resisting than the posterior. And even when the prostatic part is broken through the urine will be directed forwards to the triangular ligament as long as the sheath of fascia is entire, and then onwards along the membranous part of the tube.

VISCERAL ARTERIES OF THE PELVIS.

The visceral arteries are furnished from different sources:—Those for the bladder and the generative organs beneath it are derived from the internal iliac artery; and those for the rectum come mainly from the inferior mesenteric artery—a branch of the aorta.

a. Common iliac artery.
b. Common iliac vein.
c. Obliterated hypogastric.
d. Inferior vesical artery.
e. Branch to vesicula and prostate.
f. Branch to the bladder.
g. Middle vesical artery.
h. Upper vesical artery.
i. Upper hæmorrhoidal artery.
j., *k.*, *l.* Branches of upper hæmorrhoidal artery.
m. Gluteal artery, cut.
p. Sciatic artery, cut.
r. Branch to levator ani, cut.

The *vesical arteries* are two or three in number: when there

are three, as in the Plate, they have the undermentioned distribution.

The *upper vesical*, *h*, is the smallest, and accompanies the obliterated hypogastric, of which it appears to be a pervious part, as far as the top of the bladder: its offsets are few, and inconsiderable in size.

The *middle vesical*, *g*, supplies the body of the bladder, and communicates with the other arteries of that viscus.

The *inferior vesical*, *d*, ramifies in the fundus of the bladder, and gives branches to the vesicula seminalis, B, and the prostate, L. Usually it furnishes an offset to the rectum (middle hæmorrhoidal), but in this body the gut was not supplied by it. On the prostate the branches become tortuous.

Hæmorrhoidal arteries. The rectum is provided with vessels from three sources: — upper hæmorrhoidal, *i*; middle hæmorrhoidal from the internal iliac (Plate XLI. *g*); and inferior hæmorrhoidal from the pudic artery (Plate XXIX. *b*).

The *upper hæmorrhoidal*, *i*, is the termination of the inferior mesenteric trunk. Placed at first at the back of the rectum, it divides into six or seven branches about the middle of the gut: these descend around the intestine, three being marked, *j*, *k*, *l*, and pierce the muscular coat about three inches from the anus. Inside that layer the branches are continued nearly to the anus, where they communicate together in a series of loops beneath the mucous membrane.

The *vein* accompanying the artery has a similar looped arrangement of its branches within the anus; and these loops projected through the anus, but altered in their structure and use, form hæmorrhoids (p. 242).

NERVES OF THE PELVIS.

Both spinal and sympathetic nerves are distributed in the pelvis.

1. Vesical nerves.
2. Nerve to levator ani.
3. Nerve to coccygeus.
4. Sacral plexus, cut.
5. Left part of hypogastric plexus.
6. Part of the pelvic plexus.
7. Offsets of the knotted cord of the sympathetic to hypogastric plexus.

Spinal nerves:—These are supplied to some muscles, and to the viscera in part.

Only two of the *muscular branches* are shown: they are furnished by the fourth sacral nerve. The nerve marked, 2, belongs to the left half of the levator ani, and enters the inner surface; another nerve to the coccygeus, 3, penetrates into the fibres on the pelvic aspect of its muscle; and the third descends to the perinæum to supply the external sphincter (Plate XXIX. 5).

Nerves to the viscera, 1, are derived from the fourth or the third sacral nerve, and occasionally from both those nerves; they supply chiefly the lower part of the bladder, and before they reach that viscus they communicate freely with the pelvic plexus of the sympathetic.

Sympathetic nerve. One part of the sympathetic is distributed altogether to the viscera, and the other is a knotted cord in front of the sacrum: a similar arrangement exists on each side of the pelvic cavity. Only an outline of the visceral part is here sketched.

Hypogastric plexus. In front of the sacrum is a plexus of the sympathetic with this name; and on each side proceeds an offset, 5, in the form of a flattened band without ganglia. This prolongation communicates with the knotted cord lying on the sacral vertebræ by means of the small nerves, 7, 7; and, below, it ends in the pelvic plexus.

Pelvic plexus. This is a large network on the side of the bladder and rectum, of which only a fragment is represented by the figures, 6, 6. It receives, above, the part, 5, of the hypogastric plexus, and is joined behind by large branches from the spinal sacral nerves in the pelvis. Offsets are furnished by it to the bladder and the rectum, and to the vesicula seminalis, penis, and urethra: of these, the nerves to the bladder are larger and whiter than the rest, and receive more spinal nerve-fibres.

A view of this plexus has been omitted from the Plate because the dissection of its ramifications is in general too difficult for the student to execute, and because the insertion of so large a mass of nerves would interfere with the sight of the pelvic viscera.

DESCRIPTION OF PLATE XLI.

A SIDE view of the viscera of the female pelvis is pourtrayed in this Figure.

The right limb was detached from the trunk as the first step in the dissection; and the levator ani having been thrown down, the fat and fascia were removed from the vessels and the viscera. The peritoneum was taken away, in part, to demonstrate the extent of the pouches of that membrane before and behind the womb. For the purpose of supporting the hollow viscera, so as to render them more easy to be cleaned, some tow was introduced into the rectum and vagina, and air into the bladder.

CONNECTIONS OF THE PELVIC VISCERA.

In the female pelvis are contained the bladder and the rectum, as in the male; and between them the uterus and the vagina are interposed.

A. Body of the uterus.
B. Vagina.
C. Lower part } of the rectum.
D. Upper part }
E. Round ligament of the uterus.
F. Ovary.
G. Fallopian tube.
H. Urinary bladder.
I. Urethral tube.
J. Ureter.
K. Triangular ligament.
L. Constrictor vaginæ.
M. Psoas magnus, cut.
N. Recto-uterine pouch.
O. Vesico-uterine pouch.
P. Levator ani, cut.
Q. Ligament of the ovary.
R. Coccygeus muscle.
S. Pyriformis, cut.
T. Gluteus maximus, cut.

Rectum, C, D. This part of the large intestine has the same extent and curve in the two sexes; but in this body there was a deeper indentation than usual near the lower end of the sacrum.

Behind it are the sacrum and coccyx; and in front it touches the uterus and vagina, which separate it from the bladder and

urethra. It pierces the recto-vesical fascia, like the gut in the male, and is uncovered by peritoneum for about four inches below. Its vessels and nerves are similar to those in the male.

Bladder, H. Like the corresponding organ in the other sex, it is the most anterior and superficial of the pelvic viscera, but it does not descend so low in the cavity of the pelvis, as in man.

Its form differs somewhat from that of the male bladder: thus it is less deep, and is wider below from side to side than from before back; the under part or base is flatter, and does not project so much below the urethra.

The connections with parts around are similar to those of the male at its upper part, at each side, and in front; but they differ below and behind. Posteriorly the bladder touches the uterus; and inferiorly it rests upon the vagina.

The *urethra*, I, is a short narrow passage which reaches from the bladder to the vulva. It measures about one inch and a half in length, and is therefore much shorter than the urine-tube in the male.

Its position is above the vagina, and in its course to the exterior of the body it has the following connections. At first it is surrounded by the vascular structure of the vagina, so as to seem to form one mass with that tube before a separation has been made by dissection; then it pierces the triangular ligament of the urethra, and is surrounded by the fibres of the constrictor urethræ muscle between the layers of that structure; and lastly it ends in the bottom of the vulva, about a quarter of an inch above the opening of the vagina.

This short canal of the female answers to the prostatic and membranous parts of the male urethra (Plate XL.).

The *ureter*, J, differs from the corresponding tube of the other sex in having a longer course in the pelvis, and in crossing the side of the uterus before it reaches the bladder.

The *uterus*, or womb, A, is a thick muscular viscus with a small central cavity for the reception of the ovum. Somewhat pyramidal in form, with the larger end upwards and flattened from before back, it measures about three inches in length, two in breadth, and one in thickness.

Its upper end, large and rounded, is named the fundus. About two thirds down it decreases much in size; and this narrowed part, neck or cervix, is received into the vagina, B. The intermediate part of the viscus is the body. The anterior surface is flattened; the posterior is rounded; and the narrow sides slope gradually towards the neck.

The cavity in the interior is flat and triangular: it communicates below with the vagina by an oval opening, or the mouth of the uterus, *os tincæ;* and on each side above is a small round aperture into the Fallopian tube, G.

The uterus and the vagina are interposed between the bladder and the rectum; and the womb is supported in its place by ligaments connecting it to the abdominal wall. In the unimpregnated condition the uterus is placed below the brim of the pelvis; and it sinks down lower in the dead body. Its upper end is directed forwards, and the lower backwards; and a line through the centre would correspond with the axis of the inlet of the pelvis; if that line was prolonged upwards it would touch the abdominal wall a little above the pubes.

The anterior flattened surface touches the back of the bladder, and is covered in part by peritoneum: commonly the serous membrane reaches only half or two thirds down, and the cervix is united by fibrous tissue to the bladder; but in the body from which the Figure was taken, the whole of the anterior surface was clothed by that membrane. The posterior surface, rounded, is turned to the rectum, and is entirely covered by peritoneum.

The upper end is in contact with the small intestines, which descend into the pelvis in the woman; and the lower end is received into the vagina in such a way as to be covered higher behind than in front.

On each side the uterus gives insertion to a broad fold of peritoneum, which is attached externally to the wall of the pelvis, and divides the cavity into two—an anterior, containing the bladder, and a posterior, the rectum. In this fold are included the three uterine appendages, viz: the Fallopian tube, G; the round ligament, E, and the ovary and its ligament, F; and

these are placed from above down in the order in which they are here enumerated.

The *vagina*, B, is a tube which reaches from the uterus to the vulva on the exterior of the body. It takes a curved course in front of the rectum, and below the bladder and urethra. The fore part is shorter than the hinder; and a line through it would correspond with the axes of the cavity and outlet of the pelvis.

When distended it is roundish in form, but in the natural state it is flattened from before back except at the ends. It measures about five inches in length.

In its course it pierces the recto-vesical fascia, receiving from this a sheath on the lower half; and it is transmitted through the lower part of the triangular ligament of the urethra. The upper end is attached to the neck of the uterus, reaching farther on the posterior than the anterior surface; and the lower end is surrounded by the constrictor vaginæ muscle, L. At the outer orifice in the child, and in the virgin state, there is an occluding structure called the *hymen*.

The *constrictor vaginæ*, L, is an orbicular muscle around the end of the vagina. It is attached in front on each side to the clitoris: from this spot the fibres pass back on the sides of the vaginal aperture, and end at the central point of the perinæum, some joining the external sphincter ani.

The muscle constricts the vagina; and possesses at one time a voluntary, and at another an involuntary action, like the ejaculator urinæ by which it is represented in the other sex.

Peritoneum in the pelvis. The serous membrane is reflected over the viscera so as partly to cover and fix them to the wall of the pelvis, after a similar manner in both sexes.

Surrounding the upper half of the rectum it attaches the gut to the wall behind by a fold—the meso-rectum. In front of the intestine it is reflected on the back of the vagina and the posterior surface of the uterus, and forms the recto-uterine pouch between the womb and the rectum. On each side of the uterus it is extended outwards in a wide piece to the side of the pelvis, giving rise to the broad ligament, which contains and supports the Fallopian tube, G, the round ligament, E, and the ovary with its

ligament, F. The membrane may be then traced over the front of the uterus to the back of the bladder, and forms between those viscera the vesico-uterine pouch. And finally it covers all the posterior surface of the bladder included between the two obliterated hypogastric arteries, *c*.

The *recto-uterine pouch*, N, of the peritoneum resembles the recto-vesical in the male. Below it reaches beyond the uterus and touches the back of the vagina. On each side, as in the male, are the visceral arteries and the ureter, invested by the serous membrane.

The *vesico-uterine pouch*, O, intervenes between the bladder and the uterus, and extends downwards usually only two thirds of the anterior surface of the womb, but in the body from which the Figure was taken it was prolonged as far as the tube of the vagina (as behind) with which it was in contact.

Appendages of the uterus. These are enclosed in the broad ligament, and are three in number on each side, viz. Fallopian tube, round ligament, and ovary and its ligament.

The *Fallopian tube*, G, lies along the upper free edge of the broad fold of the peritoneum, and is about four inches in length. By the inner end it is attached to the body of the uterus, and at the outer it terminates in a free dilated extremity—the infundibulum or pavilion. Between the extremities it has a curved condition with the convexity up; and it is small and round near the uterus, but gradually enlarges towards the trumpet-shaped end. It is a hollow tube; and it communicates internally with the cavity of the uterus, and externally by a small aperture with the sac of the peritoneum.

The outer end is provided with points or fringes called *fimbriæ*, and with folds of the mucous membrane within. Some of these are larger than the others; and in the bottom of the dilatation surrounded by the folds is the aperture of the tube.

Its office is to convey the ovum from the ovary to the uterus; and a muscular layer, continuous with that in the wall of the uterus, enters into its structure.

The *round* or *suspensory ligament* of the uterus, E, is contained in the fore part of the broad ligament, near the top, and is inserted

into the uterus close below and before the Fallopian tube. About five inches in length, it is directed outwards from the cavity of the belly through the internal abdominal ring and the inguinal canal to the groin, where it blends with the subdermic areolar tissue. In the abdominal cavity it is invested by the peritoneum; and in the inguinal canal it is accompanied for a short distance by a process of that membrane, which is sometimes pervious to a small extent.

This band consists of fibrous tissue, and of muscular fibres continuous with those of the uterus; and its office is to assist in supporting the womb.

The *ovary*, F, is an ovalish body, something like the testicle in form, which is situate at the back of the broad uterine fold of the peritoneum, and below the other two appendages.

It is whitish in colour, with more or less of an irregular surface; and it measures about an inch and a half in length in the child-bearing period of life. Its position is horizontal, with the ends directed inwards and outwards: it is attached to the uterus internally by a special fibrous band—ligament of the ovary, Q; and externally it is connected by peritoneum to the trumpet-shaped mouth of the Fallopian tube.

This body contains a spongy substance surrounded by a dense fibrous coat; and the whole is invested by the serous membrane. There is not any excretory canal attached to it, for the Fallopian tube discharges the office of conveyer of its products of secretion.

In the ovary the ova are produced; and when these small bodies are matured they burst through the external coats, and are received into the pavilion of the Fallopian tube, which grasps the ovary at the time of their escape.

The *Ligament of the ovary*, Q, is a narrow fibrous band uniting the inner end of the ovary with the body of the uterus: it lies in the broad ligament, below the Fallopian tube.

VISCERAL ARTERIES OF THE PELVIS.

The viscera common to both sexes receive similar arteries, and those peculiar to each sex have special vessels.

a. External iliac artery, cut.
b. Internal iliac artery.
c. Obliterated hypogastric.
d. Upper vesical artery.
e. Lower vesical artery.
f. Uterine artery.
g. Middle hæmorrhoidal.
h. Vaginal artery.
i. Branches of vaginal to rectum.
j. Ending of pudic artery.
k. Gluteal artery, cut.
l. Ovarian artery.
n. Branch of ovarian to uterus.
o., *p.*, *q.* Branches of upper hæmorrhoidal artery.

Internal iliac artery, b. This large trunk furnishes visceral and parietal branches in the pelvis, as before said, p. 396; but only the arteries to the viscera are delineated in this Plate.

Common visceral branches. The arteries which have the same name and general distribution in the male and female are the vesical and hemorrhoidal.

The *vesical* arteries, two in number, upper, *d*, and lower, *c*, are distributed to the regions of the bladder indicated by their names.

The *middle hæmorrhoidal* artery, *g*, ramifies in the wall of the rectum, below the recto-uterine pouch of the peritoneum: part of it has been cut off.

The *upper hæmorrhoidal* is derived from the aorta in both sexes, and its distribution is referred to in page 329. Three of its branches, *o*, *p*, *q*, are shown on the lower part of the rectum, coursing down to pierce the muscular coat, and end in loops within it.

Special visceral branches. Three arteries are furnished to the generative organs of the female, viz. the uterine, the vaginal, and the ovarian, but only the two first are branches of the internal iliac.

The *uterine artery*, *f*, is the largest visceral branch of the iliac trunk, and is remarkable in being very tortuous at the womb. At first it is directed forwards beneath the peritoneum to the neck of the uterus; at this spot it ascends along the side to the fundus of that viscus, where it ends. Many large serpentine branches are distributed from it to the uterus, and it communicates above with the ovarian artery.

Near the cervix uteri it gives some branches to the upper part

of the vagina. By the side of the womb it supplies offsets to the Fallopian tube, and the round ligament; and these run to their destination between the layers of the broad fold of peritoneum.

The *vaginal artery*, *h*, courses forwards between the vagina and the rectum to the lower end of the vagina, where it terminates in small branches: it furnishes many offsets to both tubes.

The *ovarian artery*, *l*, corresponds with the spermatic artery of the male, and is, like this, a branch of the abdominal aorta. Arising from the great systemic vessel near the renal artery, it enters the pelvis by the side of the internal iliac, and is then continued onwards across that cavity to the ovary. This artery is flexuous, like the uterine.

At the ovary it divides into branches which enter that body; and one, *n*, runs in the broad ligament to the upper part of the uterus, and communicates with the uterine artery.

Nerves of the pelvis. The nerves of the muscles have been omitted in this view of the female pelvis; and the visceral nerves of the sympathetic have been taken away, as in the dissection of the male pelvis, because they would obscure the view of the viscera.

1. Nerves in the sacral plexus, cut.
2. Lateral part of the hypogastric plexus.
3, 3. Parts of the pelvic plexus, cut through.

The *pelvic plexus* of the sympathetic nerve (p. 330) of which parts 3, 3, remain, resembles in its composition the like plexus of the male, and supplies the viscera. It is situate by the side of the vagina, bladder, and rectum; and it furnishes common branches to the bladder and rectum, like those of the male, and special branches to the uterus and vagina.

An *ovarian plexus* of nerves accompanies the ovarian artery, and supplies the ovary and the uterus: this was taken away in the dissection.

ILLUSTRATIONS OF THE LOWER LIMB.

DESCRIPTION OF PLATE XLII.

THIS Figure shows the dissection of the superficial vessels, nerves, and glands, as well as that of the fascia lata near Poupart's ligament.

The limb being abducted from its fellow, rotated out, and supported with the hip and knee in a semiflexed position, the skin and the subcutaneous fat were removed, whilst the vessels nerves and glands contained in it were dissected out. The opening for the saphenous vein is then to be carefully defined.

SUPERFICIAL VESSELS NERVES AND GLANDS.

The cutaneous arteries and veins ramifying in the teguments of the top of the thigh are branches of the femoral trunks.

a. Superficial pudic artery.
b. Superficial epigastric artery.
c. Superficial circumflex iliac artery.
d. Saphenous vein.
e. Superficial pudic vein.
f. Cutaneous arteries of the thigh.
g. Cutaneous vein of the front of the thigh.
h. Superficial epigastric vein.
l. Superficial circumflex iliac vein.

Arteries:—The cutaneous arteries in the groin, like the tegumentary vessels in other parts, are very irregular in their arrangement: their names are taken from their distribution.

The *superficial pudic* artery, *a*, pierces the deep fascia of the limb about the mid-line; or it may come through the saphenous opening, as in the Figure: having entered the fat, it courses upwards

and inwards to end in the integuments of the pubes, penis, and scrotum. See also Plate [illegible].

A second superficial pudic artery, which lies at first beneath the fascia lata, is delineated in Plate [illegible], and will be referred to with the anatomy of the femoral artery.

The *superficial epigastric* artery, *h*, appears through the fascia near Poupart's ligament, being sometimes united with the preceding small artery, and ascends in the fat of the belly towards the umbilicus.

The *superficial circumflex iliac* artery, *c*, runs outwards at first beneath the fascia lata, and pierces that membrane towards the outer border of the thigh, to end in the integuments. Two or three offsets enter the fat at intervals; and some accompany the genito-crural and external cutaneous nerves.

Other unnamed small arteries, which accompany the nerves 4 and 5, and are marked with, *f*, are derived from the femoral trunk lower down in the thigh.

Superficial veins. The companion veins of the superficial arteries above described end for the most part in the saphenous vein.

Internal saphenous vein, d. This large cutaneous vein reaches from the dorsum of the foot to the groin, but only the upper part is laid bare in the dissection. As now seen, the vein ascends internal to the mid-line of the thigh, to about an inch and a half from Poupart's ligament, where it sinks through an opening in the fascia lata to enter the femoral trunk. Near its ending it receives the superficial pudic, *e*; the epigastric, *h*; and the circumflex iliac vein, *l*. Somewhat lower down in the thigh it is joined usually by two larger branches;—one, *g*, formed by the veins from the outer part and front of the thigh; and the other by veins from the inner and hinder parts of the thigh.

Superficial inguinal glands. These glands in the thigh are placed on the sides of the saphenous vein, and are superficial to the fascia lata. Of a flattened form and reddish colour, they vary much in size and number: in this body they were rather large and not numerous. They receive the afferent superficial lymphatics from the inner and fore parts of the limb; and trans-

mit efferent vessels through the deep fascia to communicate with deeper lymphatics. Irritation of the surface of the foot, or of the inner part of the leg and thigh, along the course of the saphenous vein, may give rise to swelling and suppuration in this set of glands.

Another group of superficial inguinal glands lies transversely along the line of Poupart's ligament. See Plate XXXII.

Cutaneous nerves. The nerves now laid bare are derived from the lumbar plexus (p. 309); and they will be followed farther in the subsequent dissection of the thigh, with the exception of the ilio-inguinal.

1. Ilio-inguinal.
2. Crural branch of genito-crural.
3. External cutaneous.
4. Middle cutaneous of the thigh.
5. Branch of the internal cutaneous of the thigh.

The *ilio-inguinal* nerve, 1, issues through the external abdominal ring, and terminates in offsets to the scrotum, and to the integuments of the thigh internal to, and rather below the saphenous opening.

FASCIA LATA AND THE SAPHENOUS OPENING.

The special fascia of the thigh, or the fascia lata, gives a sheath to the limb, and serves for the attachment of muscular fibres at certain points: it is pierced also by apertures for vessels and nerves.

A. Poupart's ligament.
B. Fascia of Scarpa, cut.
C. D. Fascia lata.
E. Falciform edge of the saphenous opening.
F. Inner part of the crural sheath.
G. Inner sharp edge of the saphenous opening.
H. Saphenous opening.
I. Opaque line of the blood-vessels under the fascia.
†† Superficial inguinal glands.

The *fascia lata* C forms a continuous tube around the thigh, and sends inwards processes to form sheaths for the muscles. White lines on the surface indicate the position of the intermuscular septa. Along the front of the thigh is a wider yellowish line, I, which marks the situation of the subjacent femoral vessels.

Only a small part of the fascia is now laid bare, and through it the saphenous vein passes. Outside the opening for the vein the fascia is united above to Poupart's ligament: here it is thick and strong, and serves to keep that ligament tense and closely applied to the parts beneath, so that it assists materially in checking the descent of a piece of intestine beneath the tendinous band. Inside the opening the fascia is much thinner, and is inserted into the pubes.

Most of the apertures in the fascia for the passage of the superficial vessels and nerves are small, but that for the saphenous vein is large and is called the saphenous opening.

The *saphenous opening*, H, is placed inside the line, I, of the femoral vessels, and is much larger than is needful for the passage of the vein and some other small vessels. Its form is semilunar with the extremities directed up and down. Its measurements are, one inch and a half to two inches in length, and about half an inch across at the widest part; but the greater width in the Figure is due to the fascia being raised by the distending with injection the subjacent vessels.

The extremities of the aperture are named cornua: the upper cornu touches Poupart's ligament, and the lower is distant about one inch and a half from that structure.

The edges have different characters:—The outer is crescentic in form, and blends with the subjacent crural sheath F: above, where it is thicker and firmer, it unites with Gimbernat's ligament (part of the insertion of Poupart). To this border, which is not free, though it has a semilunar appearance, the term falciform process or edge has been given; and the upper part, between E and Poupart's ligament A, has been called by some the femoral ligament. At the inner side of the opening the fascia lata is flattened over the subjacent pectineus muscle for half way down; but thence to the lower cornu it presents a sharp edge, G, which is continued below into the falciform part of the outer boundary.

In the area of the opening appears the loose membranous crural sheath F. To the sides of the aperture the deeper stratum of the subcutaneous or superficial fatty layer is connected by bands of fibrous tissue; and as that part stretching over the opening is

pierced by many small apertures for lymphatics and vessels, it has been named the *cribriform fascia.*

Through this aperture pass the saphenous vein, lymphatics, and one or more small superficial vessels: the vein enters nearer the lower than the upper cornu, but the others have not a fixed position.

By means of this aperture a femoral hernia comes forwards, and forms a swelling in the thigh; and as the saphenous opening serves as the aperture of exit of the hernia from the crural canal, it answers to the external abdominal ring of the inguinal hernia. The intestine escapes through the upper part of the opening, above the situation of the vein, and pushes before it, while protruding, the crural sheath in which it descends, and the thin cribriform fascia placed over that hole. As the hernial tumour enlarges it is directed upwards upon the firm outer margin of the opening—the part above E; and since the gut makes a sharp curve round the fascia it may be constricted at that spot by the thickened falciform process.

The condition of the margins of the aperture as to tightness and looseness depends upon the position of the limb, and the tension of the rest of the fascia lata. When the thigh is bent and rotated in the margins of the saphenous opening are rendered lax; but if the thigh is extended and rotated out the aperture is made tighter and smaller, and the outer edge takes on the characters of a firm constricting band. In an attempt therefore to force backwards a piece of protruded intestine into the abdomen the position of the limb should be specially attended to, for success may depend upon the greatest possible laxity being given to the edges of the saphenous opening.

DESCRIPTION OF PLATE XLIII.

In this Plate the anatomy of the crural sheath and the course of a femoral hernia may be studied.

To display the crural sheath and its vessels, throw down a triangular flap of the fascia lata; cut then transversely through the front of the crural sheath as is shown in the Figure; and remove a piece of the areolar sheath around the artery and the vein, so as partly to denude those vessels. The fat coming into view after the fascia lata is raised should be removed carefully; and the crural sheath should be detached with the handle of the scalpel from Poupart's ligament before, and from a deep piece of the fascia lata beneath it.

ANATOMY OF FEMORAL HERNIA.

As the femoral hernia descends into the thigh it passes beneath Poupart's ligament, and along the loose crural sheath to the saphenous opening. The anatomy of those parts in the thigh will be shortly detailed before the hernia is referred to.

A. Oblique part of Poupart's ligament.
B. Horizontal part of the ligament.
C. Fascia lata of the thigh.
D. Reflected part of the fascia.
E. Pubic part of the fascia.
F. Crural sheath.
G. Femoral artery.
H. Femoral vein.
I. Inguinal gland in the crural ring.
K. Crural canal.

Poupart's ligament separates the regions of the thigh and abdomen, and has been described in page 264. From its being attached to bone only at the extremities, and arching over the parts issuing from the abdomen to the thigh, it has received also the name of crural arch.

Between its terminal attachments the band is curved down-

wards to the thigh, being oblique in direction externally, and almost horizontal internally. To the lower border the fascia lata is attached; and as long as this membrane is entire the band is kept arched, but as soon as the fascia has been cut through the ligament becomes lax, and rises towards the abdomen. The space included between the ligament and the hip-bone is closed at the outer end by the large flexor muscles of the hip (psoas and iliacus), and at the inner by the femoral vessels and the crural sheath: the fasciæ too lining the cavity of the belly assist in closing the interval (Plate XXXV.). Between the ligament and the muscles there is not space for the escape of the intestine from the abdomen, but there is room for its passage in the crural sheath.

Poupart's ligament is rendered more or less resisting by the position of the limb. For instance if the limb is straight as in standing the crural arch is tense; and if the thigh is rotated out at the same time that band is made as tight as it can be. When the thigh is bent on the abdomen the tendinous cord is relaxed, and attains its greatest degree of looseness if the limb is rotated in at the same time. Of necessity this tendinous arch may act as a constricting band to a piece of intestine descending beneath it in femoral hernia.

Deep crural arch. A thin fibrous band across the front of the crural sheath has received this name. It begins about the middle of the superficial crural arch, and widening internally is attached to the pectineal line of the pubes: it consists mostly of a thickening of the membrane forming the fore part of the sheath.

The *crural sheath*, F, is a loose membranous tube around the femoral vessels, and is derived from the fasciæ lining the cavity of the belly. It lies under the inner or horizontal part of the crural arch, filling the interval not occupied by muscle; and it extends downwards about two inches before it blends with the areolar sheath around the bloodvessels. Upwards, or towards the abdomen, the fore part of the tube may be traced into the fascia transversalis; and the hinder part is described as being continuous with the fascia iliaca (Plate XXXV.)

Flattened from before back, it is triangular in form, with the base towards Poupart's ligament and the apex around the femoral

vessels. Its outer edge is straighter than the inner. This funnel-shaped tube lies in an interval between two pieces of the fascia lata: in front of it is the reflected part, D, and behind it is a deeper piece of the same fascia; from both which it can be detached with the handle of the scalpel. Perforating it are superficial vessels for the top of the thigh, and the genito-crural nerve.

This tube serves as an envelope to the bloodvessels passing from the abdomen to the thigh, and corresponds with a similar sheath on the vessels of the upper limb entering the axilla.

Interior of the crural sheath. On cutting through the front of the crural sheath, as in the Figure, the included space will be seen to be larger than is needed to lodge the femoral vessels; and to be largest internally where the tube slants most.

In the tube are contained the femoral vessels, invested each with a sheath of areolar tissue, together with an inguinal gland. The vessels lie side by side the artery being external and near to the outer border of the tube; they are united together closely by their areolar investments. When a piece has been cut out of each areolar sheath, as in the Plate, the cut edges on the sides of the vessels will appear like partitions passing from the front to the back, and dividing into parts the contained space. Commonly three such spaces or compartments are described as resulting from two septa in the interior of the crural sheath, viz. an external containing the femoral artery; a middle one, the femoral vein; and an inner space, K, which is partly filled by an inguinal gland.

Through the inner space of the crural sheath a piece of intestine descends in femoral hernia; and names have been given to parts of the passage through which it glides, which resemble the terms applied to parts of the passage for the inguinal hernia. Thus the opening into the crural sheath from the cavity of the belly is the crural ring; the space in the interior of the sheath, inside the vein, is the crural canal; and the aperture of exit is represented by the saphenous opening in the fascia lata.

The *crural ring*, or the abdominal aperture into the space in the crural sheath, is placed on the inner side of the femoral vessels,

and is on a level with the crural arch. It is about as large as the tip of the fore finger, and measures most from within out: it is closed by the inguinal gland, I, which lies in it, and by the sub-peritoneal fat (septum crurale) and the peritoneum which stretch across it above the gland.

Its bounding parts, and the vessels around, are described at page 286. (Plate XXXV.)

The *crural canal*, K, is the narrow space inside the crural sheath, which is internal to the femoral vein. It extends from the crural ring to the upper cornu of the saphenous opening, and measures from half to three quarters of an inch in length. It gradually tapers from above down, being pyramidal in form with the base upwards.

Contained in the crural sheath, it will be bounded, externally to that tube, both in front and behind by fascia lata; and it is closed below by the meeting of the femoral vein with the inner slanting side of the crural sheath.

The *saphenous opening* is concealed by the reflected piece of the fascia lata; but it is delineated in Figure XLII. Its boundaries, size, and conditions, have been described in page 342. By means of this aperture the gut comes forwards from the crural canal to the surface of the thigh; and this aperture of exit has been called the lower opening of the crural passage.

Course of femoral hernia. The piece of intestine in femoral hernia passes beneath the crural arch and within the crural sheath as before said, but it changes its direction as it proceeds onwards. Entering the crural canal through the abdominal aperture it descends vertically at first as far as the upper cornu of the saphenous opening. Next it advances through that opening to the surface of the thigh, making at first a small round tumour, but it extends transversely below Poupart's ligament as more of the gut is protruded. Finally, as the hernia enlarges it ascends over the crural arch on to the abdomen, because there is less resistance in this direction than towards the thigh. In consequence of the winding course of the intestine the last or ascending part comes to be parallel almost to the first or descending part of the tumour;

and the two are united below by a curve around the sharp ma
of the saphenous opening. In attempts to reduce a large fem
hernia the bend in the course is to be specially remembered,
the contents of the constricted gut are to be directed down
back to the upper cornu of the saphenous opening.

Whilst the intestine remains in the crural canal the herni
said to be incomplete; but if the gut has escaped from
canal, and forms a tumour on the surface, the hernia is ca
complete.

Coverings of the hernia. The investments applied to the in
tine as it descends are derived partly from strata in the abdon
and partly from structures in the thigh. In the first pl
the gut receives a sheath from the peritoneum, which fo
the sac of the hernia. In the next place it pushes onwards
elongates the layer of subperitoneal fat (septum crurale)
it enters the crural ring, and causes the inguinal gland to
pushed aside or absorbed. With those two strata derived fi
the abdomen it traverses the crural canal as far as the sap
nous opening; and at that point it will obtain the next
coverings of the crural sheath and the cribriform fascia, thou
it may burst through one or both of these. And lastly it stretc
and forms coverings for itself of the subcutaneous fatty layer a
the skin.

Six layers are thus enumerated as the coverings of a compl
femoral hernia. In a recent tumour the several strata may
separated from each other; but in an older large hernia the cov
ings derived from the septum crurale and the crural sheath
conjoined, and form the fascia propria of Cooper. During
operation the surgeon might be able to recognise only four, v
the skin and the subcutaneous fatty layer, the fatty subperitone
covering, and the peritoneal sac.

Diagnosis. The tumour of a complete femoral is general
smaller than that of an inguinal hernia; and its deeper part
neck can be traced down to the hollow at the upper and inn
part of the thigh, that is, to the upper cornu of the sapheno
opening. Should it be larger in size, it extends transversely alo
the line of Poupart's ligament, instead of descending towards t

scrotum as in the inguinal hernia. It can be distinguished with certainty from the inguinal hernia by the position of its neck beneath the crural arch; for if the finger can detect the cord of Poupart's ligament passing over the neck of the tumour there cannot be any doubt of the hernia being femoral.

Taxis and truss. Before attempts are made to replace the intestine in the cavity of the abdomen, the limb is to be raised and rotated in, and the shoulders are to be elevated at the same time, with the view of relaxing to the utmost the rigidity of the fibrous structures amongst which the intestine passes. Then pressure is to be made with one hand to the fundus of the tumour, whilst the two first fingers of the other are to be applied to the neck of the hernia to direct the contents of the intestine round the falciform edge of the saphenous opening, and upwards along the crural canal to the cavity of the abdomen. Whilst practising the manipulation the force employed is to be moderate but sustained. If the tumour has extended upwards on the abdomen it should be brought downwards towards the saphenous opening, in order that the bend around the falciform process of the fascia lata may be obliterated or greatly diminished.

After the hernia has been reduced its re-descent is to be stopped by a truss; but as the pad of this instrument cannot compress the internal crural ring, through which the intestine begins to descend, it is to be placed below Poupart's ligament, over the upper and inner part of the saphenous opening.

External stricture. The strangulation of the intestine will be produced generally by a constricting fibrous band around and outside the neck of the sac of the hernia. The seat of the constriction may be at the level of Poupart's ligament or of the saphenous opening, but both are near together, the spots being only about half an inch apart. In the former situation it is occasioned by the firm edge of the band formed by Gimbernat's ligament and the crural arch; and in the latter by the sharp margin of the falciform part of the fascia lata.

This stricture may be relieved without opening the sac of the hernia by cutting down to the upper and inner part of the neck of the tumour, just below Poupart's ligament, and by incising all

constricting bands external to the sac, whether at the saphenous opening or at Gimbernat's ligament. After the division of the external stricture, a slight degree of force will suffice to replace the intestine in the cavity of the abdomen.

Internal stricture. Stricture exists sometimes inside the sac of the hernia. In this case the constriction is produced, as in inguinal hernia (p. 276), by a thickening of the peritoneum of the neck of the sac, so as to form a band which diminishes the space in the interior, and impedes the passage both of the intestinal contents and of the blood of the wall of the intestine. Its position is opposite the line of Gimbernat's ligament and the crural arch.

As this kind of strangulation cannot be determined beforehand, the coverings of the hernia are to be divided at the neck of the tumour, as in the case of the external stricture; and if the sac cannot be emptied of its contents after cutting through all constricting parts external to it, the intestine is to be relieved from internal stricture by opening the peritoneal sac, and, the knife being introduced on a director beneath the thickened band, by cutting horizontally inwards towards Gimbernat's ligament. In executing this last part of the operation the surgeon does not see what the knife cuts, and therefore he uses it sparingly, for as soon as the stringlike band is divided the intestine becomes free to be passed into the abdomen.

In Plate XXXV. an inner view is given of the crural ring with the vessels around which may be endangered in an operation; and in page 289 are detailed the precautions to be taken in setting free the gut from internal stricture.

SUPERFICIAL VESSELS AND NERVES.

The cutaneous vessels and nerves which are figured in this Plate have been described in page 339; and they are marked for the most part with the same letters and figures of reference as in the preceding Plate. Consequently only their names will be given in the subjoined tables.

VESSELS.

a. Superficial pudic artery.
b. Superficial circumflex iliac artery.
c. Cutaneous arteries of the front of the thigh.
d. Internal saphenous vein.
e. Superficial pudic vein.

NERVES.

1. Ilio-inguinal nerve.
2. Crural branch of genito-crural.
3. External cutaneous of the thigh.
4. Middle cutaneous of the thigh.

DESCRIPTION OF PLATE XLIV.

A SURFACE view of the muscles of the fore and inner parts of the thigh, with the cutaneous nerves placed in position after being dissected.

The common mode of proceeding with the dissection of the thigh has been here departed from, with the view of keeping within bounds the number of the Plates. Usually the subcutaneous nerves and vessels contained in the fat are first traced out. Scarpa's space at the top of the thigh is next laid bare, and the fascia lata is then removed to bring into view the muscles. If it is wished to study Scarpa's space separately from the rest, let the lower two thirds of the Plate be covered with a piece of paper.

SUPERFICIAL NERVES AND VESSELS.

The cutaneous nerves of the front of the thigh are either direct offsets of the lumbar plexus, or are derived from branches of that plexus.

1. Ilio-inguinal nerve.
2. Crural branch of genito-crural.
3. External cutaneous.
4. Anterior crural trunk.
5. Internal cutaneous of the thigh.
6. Anterior branch of internal cutaneous.
7. Inner branch of internal cutaneous.

†† Offsets of internal cutaneous.

8. Middle cutaneous of the thigh.
9. Offset of internal cutaneous to the patellar branch of the saphenous.

10. Patellar branch of the saphenous.
11. Internal saphenous nerve.
12. Offset of saphenous to the leg.
13. Superficial part of the obturator.

Ilio-inguinal nerve, 1. This small branch of the lumbar plexus has been noticed in page 309; and it has been delineated in the preceding Plates.

Genito-crural nerve. The crural part, 2, of this nerve issues beneath Poupart's ligament at the spot here indicated, when it is larger than usual; but commonly it lies nearer to the femoral vessels, as it is shown in Plate XLIII., where it is seen to perforate the crural sheath. It comes through the fascia lata near Poupart's ligament, and ramifies in the fat about half way down the thigh. Before or after it pierces the fascia it joins the middle cutaneous nerve, 8; and in the body used for the dissection a junction took place under the fascia lata with the external cutaneous nerve, 3.

The *external cutaneous nerve*, 3, leaves the abdomen beneath the outer end of Poupart's ligament, and becomes subcutaneous about four inches from that band. It extends in the fat as low as the knee, and supplies branches to the outer and hinder parts of the thigh, behind a line drawn from the front of the iliac crest to the outer edge of the patella. One or two small branches pierce the fascia lata at a point higher than the trunk of the nerve.

Anterior crural nerve, 4. This large trunk of the lumbar plexus (p. 309) passes from the abdomen below Poupart's ligament; and lying outside the crural sheath, divides into cutaneous and muscular branches. The superficial branches are the three following, viz. the internal and middle cutaneous, and the internal saphenous. The muscular branches are shown in Plate XLVI.

The *middle cutaneous of the thigh*, 8, enters the fat about three inches from Poupart's ligament: it extends to the knee along the centre of the thigh, distributing offsets laterally, and ends in the integuments over the patella. Most commonly the nerve is subdivided into two; or there may be two distinct nerves.

Internal cutaneous of the thigh, 5. Springing from the anterior crural with the preceding, it descends beneath the fascia lata and along the edge of the sartorius, or under the muscle, as far as

the junction of the upper and middle thirds of the thigh, where it divides into two parts, which are distributed as below :—

The anterior branch, 6, winds forwards over the sartorius, A, and piercing the fascia lata in the lower third of the thigh, supplies the integuments as low as the inner side of the knee: it joins the patellar branch of the great saphenous nerve by the offset, 9.

The inner branch, 7, courses under, and along the hinder border of the sartorius to the inner side of the knee, where it is transmitted through the fascia lata; when cutaneous it is continued in the fat along the inner part of the calf of the leg, about halfway down. Near its beginning it is joined by a branch, 13, of the obturator nerve, and on the inner part of the knee there is a branch, 9, between it and the great saphenous nerve.

From the trunk of the nerve before it divides, or from its anterior branch, offsets marked thus, †, are furnished to the integuments of the inner part of the thigh in the upper half.

The *internal saphenous nerve*, 11, lying at first beneath the sartorius, as is seen in Plate XLV., escapes from beneath that muscle at the inner side of the knee; and is continued with the vein of the same name through the leg to the foot. As it becomes cutaneous it gives forwards one offset to the integuments of the front of the leg, and another backwards to join the inner branch, 7, of the internal cutaneous.

Whilst the saphenous nerve is covered by the sartorius in the lower third of the thigh it supplies a *patellar branch* 10, to the integuments of the inner and fore parts of the knee: this pierces the sartorius and the fascia, and being joined by an offset, 9, of the internal cutaneous, communicates in the fat with the middle and external cutaneous nerves, forming a plexus—the patellar.

Part of the obturator nerve. The superficial part, 13, of the obturator nerve comes forwards beneath the adductor longus muscle, H, and is inclined outwards under the sartorius muscle and the fascia lata to the femoral artery (Plate XLV.). It communicates with the internal cutaneous branch, 7, beneath the fascia; and some small offsets are prolonged through the fascia to the integuments at the inner side of the thigh.

Superficial vessels. Small arteries, for the most part unnamed, and the internal saphenous vein and its tributaries ramify in the fat of the thigh.

Cutaneous arteries. All the cutaneous nerves are accompanied by superficial arteries; but as these are small, and not so easily traced as the firmer nerves, they were not dissected farther than was necessary to give an idea of their main parts.

Ramifying with the ilio-inguinal nerve, 1, is a branch from the cremasteric artery; with the genito-crural nerve, 2, and external cutaneous, 3, are branches from the superficial circumflex iliac; with the middle cutaneous, 8, and internal cutaneous, 5, are small branches of the femoral trunk; with the saphenous nerve, 11, and with its branches, 10 and 12, are offsets of the anastomotic artery; and with the obturator nerve, 13, runs a small branch of the internal circumflex artery.

Other cutaneous arteries issue beneath the edges of the sartorius muscle, being furnished from the femoral trunk; and many small offsets, piercing the fleshy fibres of the vasti and rectus, come from the branches to those muscles.

The *internal saphenous vein, p,* lies in the fat with the superficial nerves along the inner part of the thigh. Below, it passes the knee-joint on the inner side, behind the prominence of the inner condyle, and ascends obliquely to the level of the hip-joint, where it pierces the fascia lata to join the deep vein. See Plate XLII. Large unnamed branches join it about the knee, and smaller veins in the thigh; and it receives near its ending the named veins accompanying the small superficial arteries of the groin.

SCARPA'S TRIANGULAR SPACE.

The triangular interval at the top of the thigh answers to the axilla in the upper limb. It is a rather shallow, intermuscular space, which is situate on the flexion-side of the hip-joint, and contains the main vessels of the limb, with the nerve of the front of the thigh.

Its boundaries are the following :—The base, directed upwards

to the abdomen, is limited by Poupart's ligament: in the dissected limb this band forms a straight line, but before the removal of the fascia it arches down below the level of the arteries, *b* and *c*, and diminishes the length of the space. The apex is formed by the meeting of the sartorius, A, and adductor longus, H, and points to the inner side of the mid-line of the thigh.

Towards the surface this interval is closed by the strong fascia lata, and by the teguments and the inguinal glands: this covering will vary in thickness according to the quantity of fat in the body. The floor or the deep boundary is limited by the iliacus, D, and psoas at the outer part; and at the inner part by the pectineus, G, adductor longus, H, and still nearer the femoral vessels by a small piece of the adductor brevis.

The hollow is deepest near the middle, where the blood vessels lie, and gradually becomes shallower from that point towards each side. It contains the femoral artery and vein, with their first branches, the anterior crural nerve, and lymphatics and fat.

The femoral artery, *a*, lies along the centre or deepest part of the intermuscular interval, resting above on the psoas muscle, and furnishing the large profunda and small superficial branches: it leaves the space below by sinking under the sartorius, about an inch outside the apex.

The femoral vein, *m*, lies close to, and on the inner side of the artery, gradually winding beneath that vessel near the sartorius muscle. Like the artery it is most superficial at Poupart's ligament; and at that spot it rests on the pubes, between the pectineus and psoas muscles. In the space it is joined by the saphenous or superficial, and by deep veins.

The anterior crural nerve, 4, enters the space on the outer side of the artery, and may lie close to that vessel, as in the Plate, or at a short distance from it (quarter to half an inch). Above, it lies deeply between the iliacus and psoas, and separated from the artery by a bundle of muscular fibres. About two inches from Poupart's ligament it breaks up into superficial and muscular branches; but before this final division it sends one or two small branches beneath the femoral vessels to the pectineus muscle.

Deep lymphatics lie around the femoral vessels; and they receive

superficial lymphatics near Poupart's ligament: upwards they are continued into the abdomen.

SURFACE MUSCLES OF THE FRONT OF THE THIGH.

Only one muscle—the sartorius, A, is completely laid bare in the surface view of the fore and inner parts of the thigh. Inside, or above the sartorius are two groups of muscles, the flexors of the hip and adductors of the thigh; and below the sartorius lies the extensor group of the knee. Altogether at the upper and outer part appears a small muscle (tensor vaginæ femoris), which belongs to the abductor or gluteal set of muscles.

A. Sartorius muscle.
B. Tendon of the sartorius.
C. Tensor vaginæ femoris.
D. Iliacus muscle.
E. Rectus femoris.
F. Vastus internus.
G. Pectineus muscle.
H. Adductor longus.
I. Gracilis muscle.
J. Tendon of adductor magnus.
X. Spot for ligature of the femoral artery.

The *sartorius*, A, is the longest muscle in the body. It crosses obliquely the thigh from the hip-bone on the outer side to the tibia on the inner, and lies in a hollow between the adductors of the thigh and extensors of the knee.

The muscle is narrow at its origin, and is attached to the upper iliac spinous process and to half of the notch between the two spinous processes. The fibres form a thin widened belly on the thigh, and end below in a short flat tendon, B, which is inserted into the inner surface of the tibia near the tubercle: from the upper border of the tendon one expansion is continued to the knee-joint capsule, and from the lower border another is prolonged to the fascia of the leg.

The sartorius conceals the greater part of the femoral vessels, and the branches of the anterior crural nerve. It rests on the following muscles:—along the inner edge, from above down, come the iliacus, D, pectineus, G, adductor longus, H, gracilis, I, and the inner hamstrings; and along the lower edge are the tensor vaginæ femoris, C, rectus, E, vastus internus, F, and tendon of the adductor magnus, J. Just above the knee it

bounds the popliteal space with the inner hamstrings; and this part is pierced by the patellar branch, 10, of the saphenous nerve.

The action of the muscle is exemplified in the posture of squatting. By its contraction the hip-bone is drawn forwards, the tibia backwards, and the fascia lata is rendered tense at the same time. If the pelvic end is fixed and the tibia free, the knee-joint will be bent; and if the tibial extremity becomes the fixed point the pelvis will be supported and drawn forwards. In standing on one leg, say the right, the muscle of the same side will assist in turning inwards the pelvis on the top of the femur, and in rotating the trunk to the left side: with the left muscle acting in the same way the trunk will be moved in the opposite direction.

Flexor muscles of the hip-joint. These are two in number, viz. the psoas and iliacus (p. 296); but only the latter, D, is now visible, as the psoas is concealed by the femoral artery. Both arise in the abdomen, and issue thence beneath Poupart's ligament to be inserted into, and in front of and below the small trochanter of the femur.

The *adductor muscles of the thigh* form the large fleshy mass at the inner side of the femur: they are five in number, but only three, viz. pectineus, G, adductor longus, H, and gracilis, I, are in contact with the fascia. All will be more completely laid bare in subsequent Plates; and in Figure XLVII. the deeper members of the group are exhibited.

The *extensors of the knee-joint* are three large muscles, which make the bulge on the fore part of the thigh: they consist of rectus femoris, E, vastus internus, F, and vastus externus (L, Plate XLVI.). Above they are concealed for a short distance by the sartorius, A, and tensor vaginæ femoris, C; and below they blend in a common tendon, which is continued over the knee-joint to the tibia. Plate XLVI. is specially devoted to the anatomy of these muscles, and of the vessels and nerves belonging to them.

DESCRIPTION OF PLATE XLV.

THE anatomy of the femoral vessels and anterior crural nerve may be acquired from this Figure.

After the completion of the dissection for the preceding Plate the chief nerve and vessels on the front of the thigh will be brought into view by removing the cutaneous nerves, and by taking away the greater part of the sartorius muscle. On the removal of the fat and an aponeurosis beneath the sartorius the nerve and vessels will be visible.

SURFACE MUSCLES OF THE FRONT OF THE THIGH.

The connections of the several superficial muscles can be perceived in this Figure; but the description of each will be given subsequently with the group of muscles to which it belongs: they are marked by the same letters of reference as in Plate XLIV.

A. Ends of the sartorius.
B. Gluteus maximus.
C. Tensor vaginæ femoris.
D. Iliacus.
E. Rectus femoris.
F. Vastus internus.
G. Pectineus.
H. Adductor longus.
I. Gracilis.
J. Adductor magnus.
K. Semi-membranosus.

FEMORAL ARTERY AND VEIN.

The main blood vessels of the lower limb, like those of the upper, are large single trunks as far as one bone exists in the member, and divide into branches in the leg where two bones are present.

a. Femoral artery.
* Spot for ligature.
b. Circumflex iliac branch.
c. Epigastric branch.
d. Superficial circumflex iliac.
e. Superficial pudic.
f. Deeper superficial pudic.
g. Profunda artery.
h. Anastomotic artery.
i. Superficial branch of anastomotic.
† Cutaneous arteries of the femoral.
j. Ending of external iliac artery.
k. Femoral vein.
l. Superficial pudic vein.
n. Deeper superficial pudic.
o. Profunda.
p. Saphenous vein cut.

The *femoral artery*, *a*, is continuous directly with the external iliac, and reaches beyond the knee, like the brachial beyond the elbow, before it breaks up into secondary trunks. Its extent is marked in one direction by the lower border of Poupart's ligament, and in the other by the opening in the adductor magnus: finally it turns to the back of the limb at this aperture, and obtains the name popliteal.

Its course in the limb is oblique; for near the pelvis the vessel lies over the hip-joint, whilst below it is placed inside the femur. And its position in the thigh would be marked by a line on the surface from midway between the symphysis pubis and iliac crest to the prominence of the inner condyle of the femur, when the knee is half bent, and the thigh bone rotated out. Pressure applied to the artery in the middle third of the thigh should therefore be directed outwards towards the bone; and when employed above, it must be made directly backwards against the hip-joint.

At the top of the thigh the vessel is near the surface and is uncovered by muscle, but in the rest of its extent it is concealed by the sartorius (see Plate XLIV.). In the description of its connections the artery will be divided into a superficial and a deep part.

The *superficial part* (Plate XLIV.) is contained in Scarpa's triangular space, and measures from three to four inches in length according to the width of the sartorius muscle. It lies nearly in the centre of the space, and its position in the limb may be ascertained by means of the upper part of the line before given for the course of the femoral trunk.

At first the artery is incased in the crural sheath with the femoral vein (Plate XLIII.). Between it and the surface of the limb lie the common teguments, with inguinal glands and the

fascia lata. The vessel rests at first on the psoas muscle, and is placed lower down over the pectineus, G, but at some distance from it, the profunda and circumflex vessels with fat intervening.

To the inner side and close to the artery lies the femoral vein, which inclines gradually behind that vessel towards the apex of the space.

Outside the artery, either close to, or at a little distance from it, is the anterior crural nerve: this divides into many branches in the space of Scarpa; and of these, the internal cutaneous, 5, crosses over the artery near to or beneath the sartorius.

The *deep part* of the artery (Plate XLV.) is contained in an intermuscular interval inside the femur, which has been called Hunter's canal. Superficial to the vessel in this hollow is the sartorius, A; with an aponeurotic layer beneath that muscle, which is stretched between the vastus internus, F, and the adductor longus and magnus muscles, H and J: this layer does not appear in the Figure, as it was removed in the dissection. Beneath the vessel lie the adductors, viz. pectineus, G (the lower end), adductor brevis (a small piece), adductor longus, H, and adductor magnus, J. On the outer side is the vastus internus, which separates the artery from the femur. Inferiorly the artery issues from that space through the aperture in the adductor magnus muscle.

The femoral vein is closely applied to the artery throughout, and winds behind it from the inner to the outer side. The superficial or internal saphenous vein has a position inside the line of the blood vessel, but oftentimes an external branch of that vein crosses the artery (Plate XLII. *g*).

The internal saphenous nerve, 13, runs with the artery; it is outside that vessel above, but inside below, and crosses beneath the aponeurosis over the artery.

Position and size of the branches. Most of the unnamed branches of the femoral artery are small in size and cutaneous, and arise at tolerably regular intervals along the trunk. From the beginning come three small named branches (Plate XLII.), viz. superficial epigastric, *b*, circumflex iliac, *c*, and pudic, *a*. Two inches lower down arises the large profunda trunk, *g*, for the supply of

the thigh. And close to the ending springs the small anastomotic artery, *h*, of the knee-joint.

Of these branches the profunda is the largest; and to it the term deep femoral has been given. It arises commonly from the second inch of the femoral trunk, varying much as to its site within that limit; but its origin takes often a much wider range as the observations of Mr. Quain have demonstrated.* Thus it may be attached to the first inch of the femoral, or even higher, so as to come from the end of the external iliac. Or it may leave the parent vessel lower in the thigh, arising as far as four inches from Poupart's ligament; but in this state of deviation its circumflex branches are usually attached higher up and separately to the femoral trunk. As the attachment of this large vessel ranges then over the upper four inches of the femoral artery a ligature cannot be applied to that part of the vessel without the prospect of subsequent hæmorrhage.

Ligature of the femoral. As this vessel, like the artery of the upper limb, is conveniently placed for the employment of pressure to control the circulation of the blood, the operation of tying it with a thread for the treatment of aneurism in the popliteal space will be resorted to but rarely; but should such a proceeding be required the following directions may be useful in its execution.

The spot chosen for ligature is determined by the place of origin of the profunda, as the surgeon desires to place the thread on the femoral trunk beyond the large nutritive and anastomotic branch. But as the origin of the profunda wanders over the highest four inches of the femoral artery a spot between four and five inches from Poupart's ligament, which is marked thus, X, in the Figure, is to be selected as the most suitable for that operation, even though the vessel is not so accessible as it would be in Scarpa's triangular space.

The position of the femoral artery in the limb may be ascertained by a line on the surface from the mid point between the iliac crest and the symphysis pubis to the inner condyle of the

* In the work before referred to on the Surgical Anatomy of the Arteries.

femur, the hip and knee-joints being slightly bent at the time, and the thigh rotated out. This line is to serve both as the superficial and deep guides; and if it is not accurately taken and strictly kept some difficulty may be experienced in finding the artery, as there is not any deep part to guide to the position of the blood vessel.

In executing the steps of the operation the fore finger of the left hand is placed opposite the part of the vessel to be tied, and the knife incises the integuments for three inches, the centre of the cut being marked by the finger; and as there may be a large branch of the saphenous vein crossing the artery the knife should be used cautiously at this stage. The fascia lata should next be cut for the same extent as the skin and fat. Then the fibres of the sartorius, which are inclined downwards and inwards, will appear in the bottom of the wound. This muscle is next to be reflected with care from the artery, and to be drawn to the outer side of the wound; and underneath the spot occupied by the sartorius the femoral artery may be recognised during life by its pulsation, and in the dead body by its colour.

The next step is to detach the artery from the surrounding parts. For this purpose seize the areolar sheath with a forceps and open it with a part of the scalpel at some little distance from the point, avoiding if possible the internal cutaneous nerve. The sheath being still held in the forceps separate the artery from this and the companion vein by a blunt instrument, such as a director introduced through the opening in the areolar investment.

Raising the sheath with the forceps the operator introduces the aneurism needle between the artery and vein; and then elevating the opposite side of the sheath, he passes the instrument gently round the artery. Finally setting free the thread from the needle in the usual way, the surgeon ligatures the femoral trunk; but in the living body he ascertains beforehand that the vessel pulsates on compression with the finger. Gentleness and tact are required in passing the needle, lest the instrument should pierce either of the large blood vessels; but if the aneurism needle is carried from right to left puncture of either is less likely to happen than if it is moved in the opposite direction.

Should the artery be deprived of its sheath to a greater extent than is needed for the passage of the aneurism needle, it should be secured by two ligatures—one at each end of the denuded part.

On reaching the artery the operator may find the origin of the profunda at that point; or possibly, though but rarely, the femoral trunk split into two;—In each case he would include both vessels in ligatures.

Usually the femoral vein is not seen in the operation specified; but if it is split, or if one of its pieces crosses over the artery it may be in the way of the knife in opening the sheath.

Branches of the femoral artery. The first three branches are small and cutaneous, and are named superficial *pudic*, *epigastric*, and *circumflex iliac:* these have been noticed with Plate XLII. Another superficial pudic branch is the following:—

The *inferior* or deeper *superficial pudic* arises rather lower from the femoral trunk: it runs beneath the fascia lata and the gracilis muscle to the inner side of the thigh, where it ends in the tegu-ments of the limb and scrotum, and in the labium pudendi of the female. Small collateral offsets are furnished to the muscles with which it is in contact.

The *profunda artery*, *g*, arises about an inch and a half from Poupart's ligament, and descends in the thigh beneath the femoral artery, as is shown in Plate XLVII. It supplies large nutrient and anastomotic branches to the thigh.

Cutaneous and muscular branches. The small arteries to the integuments which are marked thus, †, have been described in page 354. The muscular branches from the femoral trunk are but few: they enter the vastus internus, sartorius, and adductor longus.

The *anastomotic artery*, *h*, springs from the end of the femoral, and is continued between the vastus internus and the tendon of the adductor magnus to the inner side of the knee: here it ramifies under the aponeurotic investment of the joint, and anastomoses with the other articular arteries. Offsets are given by it to the vastus internus, one crossing the lower end of the femur above the joint.

A superficial branch of the anastomotic, *i*, accompanies the trunk of the saphenous nerve beneath the sartorius, and ends in the integuments with that nerve.

The *femoral vein*, *k*, is the companion to the artery, and has the same extent. Closely united throughout to the artery it changes its position to that vessel about the middle of the thigh, for it is on the inner side above, but on the outer side below. Near Poupart's ligament it is placed over the interval between the psoas and pectineus, but farther in the thigh it has connections with parts around like those of the artery.

Its branches are similar for the most part to those of the artery, but they have been taken away in the progress of the dissection. Near the top of the thigh it receives in addition the superficial or saphenous vein; and at the same place it is joined by the small vein, *n*, accompanying the deeper of the two superficial pudic arteries.

ANTERIOR CRURAL NERVE.

This large nerve of the lumbar plexus (p. 309) divides in Scarpa's triangular space into a superficial and a deep set of branches.

The *superficial set* consists of internal cutaneous, middle cutaneous, and internal saphenous; but as the middle cutaneous has been noticed sufficiently with Plate XLIV. it will not be referred to again.

The *internal cutaneous nerve*, 5, inclines beneath the sartorius to the inner side of the thigh, and divides into two parts, anterior and inner.

The anterior part, 6, is delineated in Figure XLIV., and its description is given in page 353.

The inner part, 7, descends along the inner border of the sartorius nearly to the knee, where it becomes a cutaneous nerve of the leg (Plate XLIV.). Near its beginning it is joined by an offset from the obturator, 15; and lower down (occasionally) by a branch, 8, from the internal saphenous. See also p. 353.

The *internal saphenous nerve*, 13, courses beneath the sartorius, and at the insertion of that muscle becomes cutaneous below the

knee: it is then continued through the leg to the foot. For two-thirds of its extent in the thigh it accompanies the femoral vessels, crossing over them from the outer to the inner side, and lying under the aponeurotic layer over them; but beyond the opening in the adductor magnus the superficial branch, *i*, of the anastomotic artery runs with it.

One or two branches are furnished by the nerve:—an occasional offset, 8, communicates with the internal cutaneous nerve; and a large patellar branch, 14, pierces the sartorius to ramify in the teguments over the knee (p. 353).

The *deep set of branches* of the anterior crural are furnished to muscles; they supply the extensors of the knee-joint, and the sartorius and pectineus.

The branch to the sartorius, 3, has been separated from its muscle: oftentimes an offset of the middle cutaneous enters the sartorius.

The nerve to the rectus, 9, has been cut through as it penetrates the muscular fibres.

The nerve to the vastus internus, 11, pierces the fleshy fibres about the middle of the thigh. As it is about to enter it gives a slender articular branch, 12, to the knee-joint, which runs on the surface of the vastus, covered at places by some fleshy fibres, and accompanies lower down the anastomotic artery to the joint. In this body a second articular branch issues from the fleshy fibres nearer the knee.

The nerve to the vastus externus, 10, will be described with the following Plate.

The nerves to the pectineus, 2, one or two in number, arise higher than the rest, and cross beneath the femoral vessels to be distributed to their muscle: for their ending, see Plate XLVI.

Obturator nerve, 15. A small part of this nerve is included in the dissection, but its distribution is visible in Plate XLVII., with which it will be described.

DESCRIPTION OF PLATE XLVI.

THIS Illustration shows the dissection of the deep musc the fore and outer parts of the thigh, with their vessels nerves.

The thigh having been prepared for the drawing of the ceding Figure, the dissection for this Plate will be complete cutting through the rectus muscle, and removing the fat fro branches of the external circumflex artery and anterior c nerve. With the handle of the scalpel the outer vastus, L, be separated above from the inner vastus, F, where vessels nerves intervene; and the thin aponeurosis, O, which is tinued from their common tendon over the knee-joint, may b through and raised to the sides of the knee. All the fascia on the outer part of the thigh is to be removed, except a na slip with the insertion of the tensor vaginæ femoris.

MUSCLES OF THE FRONT OF THE THIGH.

The chief fleshy mass on the front of the femur is formed the three parts or heads of the extensor of the knee-joint; b the upper and outer parts of the thigh are the small te vaginæ femoris, and the gluteal muscles.

A. Sartorius, cut.
B. Gluteus medius.
C. Tensor vaginæ femoris.
D. Iliacus.
E. Rectus femoris, cut.
F. Vastus internus.
G. Pectineus.
H. Adductor longus.
K. Adductor brevis.
L. Vastus externus.
M. Gluteus minimus.
N. Ligamentum patellæ.
O. Expansion from the ext tendon of the knee.
P. Tendon of the extensor c

The *tensor vaginæ femoris*, C, is a small muscle, whicl

attached by one end to bone, and by the other to the fascia lata. It takes origin from the upper iliac spinous process, from the contiguous part of the iliac crest, and from half the notch between the two iliac spinous processes ; reaching downwards at the outer side of the thigh, it is inserted into the fascia lata where the upper and middle thirds meet.

The muscle is incased in strong fascia, and is placed between the gluteus medius, B, behind, and the sartorius, A, and rectus, E, in front. Underneath it lies the upper part of the vastus externus, L, and the ascending branches, *f*, of the external circumflex artery. A small nerve, 1, and arterial offsets enter the under surface.

The muscle can abduct the thigh from the other limb, and make tense the fascia, deriving from this circumstance the name tensor of the fascia lata. After the thigh has been rotated out the muscle will act as an internal rotator of the femur.

The *extensor of the knee* (triceps extensor cruris) consists of three separate parts or heads, viz. rectus femoris, E, vastus internus, F, and vastus externus, L, which are united below in a common tendon.

Rectus femoris, E (Plate XLV.). This spindle-shaped muscle forms the middle or long head of the extensor. It arises from the hip-bone by two tendinous pieces :—one is attached to the anterior inferior iliac spinous process ; and the other, longer and wider, is fixed to the depression above the acetabulum. Inferiorly the muscle becomes tendinous, and blends in a common tendon of insertion, P, with the other two heads of the extensor.

The rectus is superficial except above, where it is covered by the sartorius, the iliacus, D, and the gluteus minimus, M. It conceals branches of the external circumflex artery, *e*, and anterior crural nerve, 2. Some of the fleshy fibres run from a central tendon to the sides, like the feather of a quill, producing the arrangement called penniform.

The *vastus externus*, L, or outer head of the extensor, arises from the upper half of the femur by a piece from half an inch to an inch thick, being attached opposite, and to the following points of the bone, viz. outer part of the neck, all the root of the great

trochanter, the line leading from the trochanter to the linea aspera, the upper half or more of the linea aspera, and the contiguous external intermuscular septum.* For the most part tendinous above it becomes fleshy lower down, and the fibres end inferiorly in the common tendon of insertion, some of the superficial joining the rectus tendon.

The upper part of the muscle is overlaid by the rectus and tensor vaginæ femoris. Beneath this vastus lie the inner vastus in part, and branches of the external circumflex artery and anterior crural nerve. Its lower tendon occupies the under surface, and extends upwards along the anterior or free edge of the muscle.

The *vastus internus*, F, constitutes the inner or large head of the extensor. It arises from the shaft of the femur except at the linea aspera and at the surfaces behind included by the lines prolonged from that ridge of bone to the trochanters in one direction and the condyles in the other.† Necessarily the fibres cannot be fixed where the outer vastus takes origin; and they are absent from the ends of the femur, for they reach upwards only to the anterior intertrochanteric line, and cease below near the articular surface of the knee-joint.

Most of the fleshy fibres are received on a superficial aponeurosis, which unites with the other heads in the common tendon of insertion, whilst some superficial fibres terminate on the tendon of the rectus.

The upper part of the muscle is deeply placed beneath the rectus and sartorius, and vessels and nerves (Plate XLV.). Along the inner side lie the flexors and adductors of the hip-joint and the large blood vessels of the limb. Towards the knee the muscle

* The origin of the muscle here specified is that given by Cruveilhier and Theile, and is not so extensive as that assigned to it in English anatomical works: it resembles closely the attachment of the outer head of the triceps extensor brachii.

† This mass is described commonly as consisting of two muscles, vastus internus and crureus. Naturally there is not any separation between the two on the surface; and if a division is desired the mass is to be cut through longitudinally where the anterior and inner surfaces of the femur join.

becomes prominent and makes a larger surface-swelling than the vastus externus on the outer side.

Common tendon of the extensor, P. Above the joint it is formed by the union of the tendons of the three heads; and it is continued over the knee-joint, diminishing in width, to be inserted into the tubercle of the tibia, and into an inch of the bone below: between the prominence of the tubercle and the tendon is a small bursa. Contained in the tendon is the patella, N, which completely divides it into an upper and a lower part:—The upper wide part intervenes between the fleshy fibres and the base of the patella; and the lower, narrower part, called oftentimes ligament of the patella, fixes the apex of that bone to the tibia. A very thin layer of tendinous fibres passes over the cutaneous surface of the patella.

An aponeurotic expansion, O, is prolonged from the upper part of the tendon over the patella and the knee-joint, and is fixed into the bones of the leg. On the knee it unites with the fascia lata, and with prolongations from the lateral flexors to form a capsule for the knee-joint.

Subcrureus. Under the extensor for the lower fourth of the femur lie some scattered fleshy fibres, arranged frequently in an outer and an inner fasciculus, which are inserted inferiorly into the synovial membrane of the knee-joint.

Action of the extensor. The use of the muscle will vary with the fixed or moveable condition of the bones of the limb to which it is attached. If the tibia is free to be moved all three heads will advance this bone on the articular surfaces of the femur, and so extend the knee-joint. Should the tibia be immoveable, as in rising from a stooping posture, or in walking, the femur and pelvis will be brought forwards over it. By the continued contraction of the muscles after those bones are in a straight line the body will be supported in standing by the action of the rectus on the pelvis, and of the two vasti on the femur.

The fibres of the subcrureus draw upwards the synovial membrane of the knee-joint as the tibia and femur come into a straight line in extension; and they are supposed to remove that membrane out of the way of pressure by the patella.

VESSELS OF THE FRONT OF THE THIGH.

The vessel supplying the extensor muscle of the knee is the external circumflex branch of the profunda artery with its vein.

a. Femoral artery.
b. Circumflex iliac artery.
c. Epigastric artery.
d. Profunda artery.
e. External circumflex artery.
f. Ascending branch of circumflex.
g. Descending branch.
h. Transverse branch.
i. Femoral vein.

The *profunda artery*, *d*, runs beneath the femoral trunk, and distributes large branches in the thigh: of these the only one included in this Illustration is the external circumflex.

The *external circumflex artery*, *e*, is the largest branch of the profunda, and springs near the beginning of that trunk: destined for the outer part of the thigh it divides into three chief pieces amongst the branches of the anterior crural nerve.

The ascending branch, *f*, passes under the sartorius, rectus, and tensor vaginæ femoris to the back of the hip-bone, where it supplies the gluteal muscles, and anastomoses with the gluteal artery: it furnishes nutritive branches to the muscles by which it passes.

The descending branch, *g*, is the largest of the three pieces, and divides into offsets which enter the deep heads of the extensor. One branch courses over the surface of the vastus externus to the knee-joint with a small nerve.

The transverse branch, *h*, divided into two or more offsets, enters beneath the vastus externus, and piercing that muscle anastomoses with the arteries on the back of the thigh.

The *external circumflex vein* (Plate XLV. *o*) has the same general distribution as the artery, and joins the profunda vein.

NERVES OF THE FRONT OF THE THIGH.

Two nerves, viz. a branch of the gluteal, and the anterior crural, are supplied to the muscles described in this Plate.

1. Nerve to tensor vaginæ femoris.
2. Anterior crural nerve.
3. Branches to sartorius and rectus, cut.
4. Nerve to vastus externus.
5. Upper nerve to vastus internus.
6. Lower nerve to vastus internus.
7. Internal saphenous.
8. Nerves to the pectineus.

Ending of superior gluteal nerve, 1. This gluteal nerve is distributed nearly altogether to the two smaller gluteal muscles, and it ends anteriorly, as here seen, in the tensor of the fascia lata. A branch of the gluteal artery accompanies the nerve.

Anterior crural nerve, 2. The deep or muscular branches of this nerve are furnished to the triceps extensor, the sartorius, and to one other muscle, the pectineus.

Branches to rectus and sartorius, 3, 3. Each enters its muscle at the upper part; they were cut when the muscles were removed.

Branch to the vastus externus, 4. This is a large nerve, which enters the muscle above the middle: from it a slender articular offset is prolonged on the surface of the muscle, with a superficial artery, to the capsule of the knee-joint, which it pierces.

The branches to the vastus internus are two in number. The upper one, 5, is supplied to the fleshy fibres of that part named crureus; and the lower branch, 6, which is figured in the preceding Plate, belongs to the inner part of the vastus internus and the inner side of the knee-joint.

Nerve to the pectineus, 8. This branch separates from the trunk of the anterior crural near Poupart's ligament, and passes beneath the femoral vessels to enter the pectineus on the superficial surface. Oftentimes there are two nerves instead of one.

DESCRIPTION OF PLATE XLVII.

In this Illustration the dissection of the deeper adductor muscles, with the profunda artery and obturator nerve, is exhibited.

The superficial adductors having been laid bare as in Plate XLV., the pectineus and adductor longus are to be cut through; and after removing the greater part of each of those muscles, the deeper adductors, and the ramifications of the profunda artery and obturator nerve are to be cleaned.

VESSELS OF THE FRONT OF THE THIGH.

The vessel supplying the extensor muscle of the knee is the external circumflex branch of the profunda artery with its vein.

a. Femoral artery.
b. Circumflex iliac artery.
c. Epigastric artery.
d. Profunda artery.
e. External circumflex artery.
f. Ascending branch of circumflex
g. Descending branch.
h. Transverse branch.
i. Femoral vein.

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The *external circumflex vein* (Plate XLV. *o*) has the same general distribution as the artery, and joins the profunda vein.

NERVES OF THE FRONT OF THE THIGH.

Two nerves, viz. a branch of the gluteal, and the anterior crural, are supplied to the muscles described in this Plate.

1. Nerve to tensor vaginæ femoris.
2. Anterior crural nerve.
3. Branches to sartorius and rectus, cut.
4. Nerve to vastus externus.
5. Upper nerve to vastus internus.
6. Lower nerve to vastus internus.
7. Internal saphenous.
8. Nerves to the pectineus.

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Branches to rectus and sartorius, 3, 3. Each enters its muscle at the upper part; they were cut when the muscles were removed.

Branch to the vastus externus, 4. This is a large nerve, which enters the muscle above the middle: from it a slender articular offset is prolonged on the surface of the muscle, with a superficial artery, to the capsule of the knee-joint, which it pierces.

The branches to the vastus internus are two in number. The upper one, 5, is supplied to the fleshy fibres of that part named crureus; and the lower branch, 6, which is figured in the preceding Plate, belongs to the inner part of the vastus internus and the inner side of the knee-joint.

Nerve to the pectineus, 8. This branch separates from the trunk of the anterior crural near Poupart's ligament, and passes beneath the femoral vessels to enter the pectineus on the superficial surface. Oftentimes there are two nerves instead of one.

DESCRIPTION OF PLATE XLVII.

In this Illustration the dissection of the deeper adductor muscles, with the profunda artery and obturator nerve, is exhibited.

The superficial adductors having been laid bare as in Plate XLV., the pectineus and adductor longus are to be cut through; and after removing the greater part of each of those muscles, the deeper adductors, and the ramifications of the profunda artery and obturator nerve are to be cleaned.

ADDUCTOR MUSCLES OF THE HIP-JOINT.

This group of muscles occupies the space between the pelvis and the femur, and consists of three adductors, with the pectineus and gracilis: two of the muscles, viz. pectineus and adductor longus, are represented in Plate XLV.

A. Sartorius.
B. Iliacus muscle.
C. Tensor vaginæ femoris.
D. Rectus.
E. Crureus, or vastus femoris, cut.
F. Vastus internus.
G. Pectineus, cut.
H. Adductor longus, cut.
I. Gracilis.
J. Adductor magnus.
K. Adductor brevis.
L. Vastus externus.
M. Semi-membranosus.
N. Obturator externus.
O. Semi-tendinosus.
P. Internal lateral ligament of knee.

The *pectineus*, G, Plate XLV., is the smallest and highest of the muscles in the adductor group. It has a fleshy origin from the ilio-pectineal line of the hip-bone, and from the smooth triangular surface in front of this line; its fibres descend and are inserted by means of a thin tendon, about two inches wide, behind the small trochanter of the femur, and into the upper part of the line leading from the linea aspera to that prominence.

The muscle is in contact with the fascia, and forms part of the inner boundary of Scarpa's space. Beneath it lie the obturator and adductor brevis muscles, with part of the obturator nerve. Along the upper border is placed the psoas with the external circumflex vessels; and along the lower is the adductor longus.

The pectineus will adduct and raise the femur if this bone is not fixed; and it will take part with the rest of its group in projecting forwards the thigh in walking. When the femur is immoveable, as in standing, it will assist in balancing, or drawing forwards the pelvis.

The *adductor longus* (H, Plate XLV.) is situate on the same level as the pectineus, but between this and the gracilis: it is narrow at its origin from the pelvis, but becomes wider below. Its upper tendon, about as large as the end of the finger, is fixed to the front of the pubic part of the hip-bone, just below the angle formed by the symphysis and the pubic crest; and the lower tendinous end is inserted into the inner lip of the linea aspera.

Partly subfascial this adductor is covered near the femur by the sartorius and the femoral vessels: by the opposite surface it touches the adductor brevis and magnus, and the profunda vessels and part of the obturator nerve.

The muscle assists in bringing forwards the femur in walking; and carrying that bone towards its fellow, it will be chiefly instrumental in crossing the thighs. If the femur is fixed, as in standing, the muscle balances with others the pelvis on the limb.

The *gracilis*, I, is a thin tapering muscle, which reaches from the pelvis to the tibia. It arises by a thin tendon, from two and a half to three inches wide, along the lower border of the hip-bone, and reaches upwards half way along the symphysis. At the lower third of the thigh it ends in a rounded tendon, and is inserted into the inner surface of the tibia, beneath the sartorius, A, but nearer the knee than the semi-tendinosus, O, which it resembles in size and form.

The muscle is superficial, and its connections are better illustrated in Plate XLIV. It lies against the adductor brevis and magnus as far as the lower third of the thigh, and thence against the semi-membranosus as it bounds internally the popliteal space. Near its insertion it is placed on the internal lateral ligament of the knee-joint, a bursa intervening; and gives an expansion to join the fascia of the leg.

With the limb free to move the gracilis will draw the femur towards the other thigh, especially after abduction of it. If the tibia is not fixed the muscle will bend and rotate inwards the knee-joint; and when the tibia cannot be moved the muscle will act on the pelvis, like the rest of the group.

Adductor brevis, K. Deeper placed than the muscles before described, it arises beneath the adductor longus from the fore part of the os innominatum, where it is attached outside the gracilis for a distance of two inches. The muscle widens below, and is inserted into the femur behind the pectineus, and into the line prolonged from the linea aspera.

It is concealed above by the pectineus and adductor longus, but as these separate from each other below they leave a large part of the muscle uncovered: near its origin it is crossed by the

a. Femoral artery.
b. Circumflex iliac branch.
c. Epigastric branch.
d. Profunda, or deep femoral.
e. External circumflex branch.
f. Internal circumflex branch.
g. Muscular branch of circumflex.
h. First perforating artery.
i. Second perforating.
j. Third perforating.
k. Continuation of profunda, or fourth perforating.
l. Anastomotic branch.

The *profunda artery, d,* arises from the femoral trunk about one inch and a half from Poupart's ligament; and it is called sometimes deep femoral from its position to the parent trunk. It courses on the inner side of the femur parallel to, but beneath the femoral trunk, as far as the lower third of the thigh, where a fine branch continues it onwards to the back of the limb. It has the following connections with muscles:—At first it rests on the iliacus, and appears external to the femoral artery in Scarpa's triangular space; then it is directed down and in under the femoral vessels, lying over the pectineus and adductor brevis; finally it enters beneath the adductor longus, and ends in a small perforating branch to the back of the thigh. Its named offsets are two circumflex, and four perforating; but it furnishes also large unnamed muscular and anastomotic branches.

Circumflex branches. Two in number, they wind backwards, one inside and the other outside the femur, like the corresponding arteries in the upper limb, and communicate at the back of the thigh.

The *external circumflex, e,* is consumed chiefly in the extensor muscle of the knee-joint (p. 370), and its ramifications are displayed in Plates XLVI. and LII.

The *internal circumflex, f,* bends back between the psoas, B, on the one side, and the pectineus and adductor brevis, G and K, on the other, and divides opposite the small trochanter into two terminal pieces—an ascending to the buttock, and a transverse to the back of the thigh (Plate L.).

In this course it furnishes an articular branch to the hip-joint, and muscular offsets to the obturator externus and the adductors: the largest of these, *g,* passes beneath the adductor brevis, supplying it and the adductor magnus, and accompanies the deep part of the obturator nerve.

Perforating arteries. Four in number, they pierce the aponeuroses of the adductor muscles, close to the femur, and are named first, second, &c. After reaching the back of the thigh they supply muscular offsets to the biceps, and then turn round the femur on the outside to end in the vastus externus. See Plate LII.

The *first perforating*, *h*, arises opposite the lower border of the pectineus muscle, and perforates the adductors brevis and magnus.

The *second perforating*, *i*, leaves the trunk half way down the adductor brevis, and passes through the same adductors as the preceding branch : it gives an offset to the shaft of the femur.

The *third perforating*, *j*, springs from the profunda at the lower border of the adductor brevis, and is transmitted through the adductor magnus to its destination.

The continuation of the profunda or the *fourth perforating*, *k*, pierces the great adductor muscle near the opening for the femoral artery.

Muscular branches of the profunda enter the adductors ; but the largest, three or four in number, pass through the adductor magnus to end in the hamstring muscles behind, where they maintain a chain of anastomoses at the back of the thigh (Plate LII.).

The *profunda vein* accompanies the artery of the same name, and ends above in the femoral vein. In this course it is superficial to its artery, and is situate between the trunks of the femoral and profunda arteries.

NERVES OF THE FRONT OF THE THIGH.

Two nerves are included in this dissection, viz. the anterior crural, and the obturator ; the first nerve and its branches are marked by the same numbers as in the preceding Figure.

1. Anterior and middle cutaneous of the thigh, cut.
2. Trunk of the anterior crural.
3. Nerve of the rectus, cut.
4. Nerve to the vastus externus.
5. Upper nerve to vastus internus.

The *lateral cutaneous* of the *last dorsal* nerve, 1, descends from the abdominal wall over the fore part of the iliac crest, and continues in the fat as far as the region of the great trochanter.

The *iliac branch*, 1′, of the *ilio-hypogastric nerve* (p. 309) crosses the iliac crest close to the bone, and commonly behind the last dorsal: it extends to the fat over the great gluteal muscle. This nerve is sometimes large, and takes the place of the last dorsal; or it may be wanting.

Posterior lumbar nerves, 2. Cutaneous branches of the posterior primary trunks of the lumbar nerves, commonly two in number, enter the teguments at the anterior border of the erector spinæ muscle, and are directed downwards over the gluteus towards the great trochanter.

Posterior sacral nerves, 3. The posterior primary trunks of the first three sacral nerves pierce the fibres of the gluteus maximus, after uniting beneath it (Plate L.). Two or three become cutaneous, and bend outwards over the gluteus; the largest is opposite the end of the sacrum.

Anterior sacral nerves, 4. Branches of the anterior primary trunks of the sacral nerves pierce the coccygeus and gluteus maximus, and end in the neighbouring integuments.

Two other small nerves of the perinæum issue beneath the lower edge of the gluteus. One is the *perinæal branch*, 5, of the fourth sacral nerve—and the other is the *inferior hæmorrhoidal* nerve, 7, of the pudic. Both of these have been noticed in page 247.

The *small sciatic nerve*, 10, of the sacral plexus appears at the lower border of the great gluteal muscle, and is then continued along the thigh (Plate LII.). Near the lower border of the muscle it gives two sets of cutaneous branches—ascending and descending.

The ascending or recurrent set, which are marked with 6, wind over the edge of the gluteus, and end in the integuments over the lower part of that muscle.

The descending set, shown by the number 9, supply the integuments of the inner part of the thigh below the buttock. One of these, 8, which is larger than the rest, is distributed to the

integuments of the scrotum or the labium, according to the sex (p. 254), and is named *inferior pudendal.*

The *external cutaneous* of the thigh, a branch of the lumbar plexus (p. 309), furnishes offsets to the fore part of the region laid bare.

The *cutaneous vessels*, like the nerves, are derived from several sources. Accompanying the last dorsal nerve, 1, is a branch of the lowest intercostal artery; and running with the ilio-hypogastric, 1′, is a small branch of a lumbar artery. With the lumbar nerves, 2, are offsets of the posterior branches of the lumbar arteries; and with the sacral nerves, 3 and 4, are branches of the sciatic artery. The offsets of the small sciatic nerve, 10, have as their companions ramifications of the sciatic artery. Through the upper part of the gluteus branches of the gluteal artery penetrate; and through the lower part, the branches of the sciatic artery. At the upper border of the gluteus appear offsets also of the gluteal artery; and small branches of the external circumflex of the profunda perforate the fascia lata over the great trochanter.

MUSCLES OF THE BUTTOCK.

Only the great gluteal muscle is dissected in this stage, but two other glutei cover the hip-bone; and one, the gluteus medius, shows through the fascia in the Plate. Issuing beneath the gluteus maximus are the hamstring muscles of the thigh.

A. Gluteus maximus.
B. Gluteus medius, covered by fascia.
C. Fascia lata of the thigh.
D. Biceps flexor cruris.
E. Semitendinosus.
F. Seminembranosus.
G. Adductor magnus.

The *gluteus maximus*, A, reaches from the pelvis to the femur, and resembles the deltoid of the upper limb in its position, and in the coarseness of its fibres.

The pelvic attachment, or the origin, is fixed from above down to the posterior third of the crest and the contiguous part of the hip bone, to the tendon of the multifidus spinæ, to the last piece of the sacrum, and to the side of the coccyx and the great sacro-

sciatic ligament. From this attachment the coarse bundles of fibres are directed downwards and outwards, and becoming tendinous are inserted into the fascia lata and the femur—about the upper two thirds joining the fascia, and the rest the bone. The precise insertion is made evident in Plate LII., where the muscle is partly cut through and reflected.

This gluteus is covered by the fascia lata and teguments; and it is in contact by the deep surface with the parts displayed in Plate XLIX. Its upper border, the shortest, is crossed by cutaneous vessels and nerves, and rests on the gluteus medius; whilst the lower border forms part of the ischio-rectal fossa, and lies over the adductor magnus and the hamstring muscles. Round the lower border wind branches of the small sciatic nerve with arteries.

If the femur is immoveable the muscles of both sides will assist in balancing the pelvis on the thigh-bones, as in standing; and if the pelvis is bent forwards, as in stooping to the ground, the large glutei will act powerfully in bringing the trunk into the erect position. In rising from the sitting to the upright posture, these muscles are chiefly active, becoming extensors of the hip-joint. In standing on one leg, say the right, the trunk will be rotated on its bony prop, so as to have the face turned to the left side.

If the thigh-bone is free to move, the muscle will rotate out the femur, and will then abduct, and carry back that bone so as to extend the hip-joint.

DESCRIPTION OF PLATE XLIX.

THE second stage of the Dissection of the buttock is depicted in this Figure.

The view here given may be obtained by cutting vertically through the gluteus maximus near the pelvic attachment, and removing carefully all the fat from the underlying muscles, vessels,

and nerves. On the fore part of the gluteus medius the fascia lata has been left.

MUSCLES OF THE BUTTOCK.

Two groups of muscles occupy the back of the pelvis, viz. the glutei or abductors of the hip, and the external rotators of the same joint.

A. Gluteus maximus, cut.
B. Gluteus medius.
C. Pyriformis.
D. Gluteus minimus.
E. Gemellus superior.
F. Obturator internus.
G. Gemellus inferior.
H. Obturator externus.
I. Quadratus femoris.
J. Adductor magnus.
L. Semitendinosus.
N. Biceps cruris.
O. Semimembranosus.
P. Vastus externus.
Q. Tensor vaginæ femoris.
R. Great sacro-sciatic ligament.
S. Fascia lata on the gluteus.

The *gluteus medius*, B, is placed farther forwards than the gluteus maximus, and the fibres converge to the top of the trochanter. It arises from the outer surface of the os innominatum between the crest and the upper curved line, except behind where the gluteus maximus is attached, extending nearly to the hinder border of the bone; and the superficial fibres are attached to the fascia lata. The muscle is inserted below across the outer surface of the great trochanter from the tip to the root.

The muscle is in part subcutaneous, and is in part covered by the gluteus maximus. Its anterior border touches the tensor fasciæ latæ, Q; and the hinder border, which is contiguous near the pelvis to the pyriformis, overlays this muscle near the femur. Between it and the pyriformis are seen the superficial part of the gluteal artery, and the superior gluteal nerve.

The action of the muscle will vary with the state of the bones as to fixedness or mobility.

Should the femur be free to be moved the muscle will abduct it from its fellow. If the bone is hanging the anterior and lower fibres will rotate it inwards. In one stage of a step in walking the fore part of the muscle acts with the smallest gluteus in bringing forwards the femur to its position in a line with the trunk.

When both legs are fixed, as in standing, this and the small gluteus will aid in balancing the pelvis on the thigh bones. When the body is propped on one leg the two smaller gluteal muscles act powerfully in keeping the hip-joint fixed; and the anterior fibres alone acting will turn the face to the same side. In walking the same glutei muscles draw the trunk over the supporting limb, giving the pitch to the pelvis.

The *gluteus minimus*, D, is covered by the preceding, and is attached to the pelvis and the thigh bone, like the medius; it resembles this muscle in its action, and it will be described with the following Plate.

External rotators of the hip-joint. This group consists of six muscles, viz. pyriformis, obturator internus and gemelli, quadratus femoris, and obturator externus. All are placed at the back of the joint, and are directed almost transversely from the pelvis to the top of the femur.

The *pyriformis*, C, arises inside the pelvis from the front of the sacrum, and as it issues from that cavity by the great sacro-sciatic notch it has a further fleshy attachment to the edge of the hip-bone, and to the great sacro-sciatic ligament, R. Outside the pelvis the muscle is inserted by a narrow tendon into the top of the great trochanter between the two smaller glutei.

The part of the muscle in the buttock is concealed by the gluteus maximus, and by the gluteus medius in part; and rests on the gluteus minimus, which separates it from the hip-joint. The upper edge lies along the gluteus medius, and the lower is near the upper gemellus, E. As it escapes from the pelvis it divides into two the great sacro-sciatic notch: through the upper part issue the gluteal vessels, and the upper gluteal nerve; and through the lower come the sciatic and pudic vessels and nerves.

Should the thigh-bone hang loosely the muscle will draw backwards the great trochanter, and give rise to rotation outwards; but should the hip-joint be bent it will abduct the femur from the other limb. Supposing the limb fixed, as in standing, the pyriformis will help to balance the pelvis; and in rising from a stooping posture it will assist in erecting the trunk. In standing

on one leg, say the right, it will rotate the trunk, turning the face to the opposite side.

The *obturator internus*, F, arises inside the pelvis, like the pyriformis, and is attached to nearly the whole inner surface of the obturator membrane, and to the greater part of the inner surface of the hip-bone behind the thyroid hole. The muscle appears through the small sacro-sciatic notch, and passes over the back of the hip-joint to be inserted into the great trochanter, in front of the pyriformis, and into the contiguous part of the neck of the femur.

Outside the pelvis the small gemelli muscles lie along the sides of the obturator; the whole is covered by the gluteus maximus, and is crossed by the sciatic vessels and nerves: underneath is the capsule of the hip-joint—a bursa intervening. In the sacro-sciatic notch the pudic vessels with nerves lie on the muscle; and the under surface, which is tendinous and divided into pieces as it rests on the bone, is lubricated by a synovial membrane.

This muscle being almost parallel to the pyriformis its action is similar on the pendent and elevated femur; on the pelvis with both legs fixed; or when supported on one leg. During walking it assists, with the other members of its group, the gluteus medius and minimus in pitching the pelvis on the supporting limb; and when the limb is swung forwards it and the other rotators will keep the foot straight.

The *gemellus superior*, E, arises from the outer and lower part of the ischial spine, and is inserted with the obturator internus which it joins. The muscle lies above the obturator internus, and is smaller than its fellow: it is often absent.

The *gemellus inferior*, G, is in contact with the lower border of the obturator internus, and is much larger than the upper gemellus. It arises from the outer edge of the groove in the hip-bone for the obturator internus; and it is inserted into the trochanter of the femur with the obturator muscle.

These muscles have the same connections as the extra-pelvic part of the obturator internus, to which they seem to be accessory heads of attachment. The upper intervenes between the obturator and the pyriformis and gluteus minimus, and the lower

separates the obturator from the quadratus femoris and obturator externus. Near the pelvis the edges are applied together to form a kind of groove which contains the obturator, but near the femur they cover the tendon of that muscle.

They act on the thigh-bone like the obturator internus, rotating out when the limb is hanging, and abducting when the femur is bent on the trunk. In standing on both legs, on one leg, and in walking, they will also assist the obturator though their power will be but small.

The *obturator externus*, H, appears as a tendon between the inferior gemellus and quadratus femoris. Its origin opposite the obturator internus from the outer part of the membrane of the same name, and in part from the pelvis, is indicated in Plate XLVII.; and the buttock part of the muscle will be illustrated in the next Plate.

The *quadratus femoris*, I, is thin and fleshy, and arises from the outer border of the tuber ischii, external to the semimembranosus and the adductor magnus. Its fibres form a squarish layer, from two to three inches wide, which is inserted into a tubercle in the posterior inter-trochanteric line, and vertically into the upper end of the femur for two inches: the line of attachment is sometimes called linea quadrati.

Covered by the same parts as the other rotators, it is also concealed at its origin by the hamstring muscles. Underneath it is the obturator externus with the hip-joint. By the upper border it touches the inferior gemellus and obturator externus; and by the lower it is in contact with the adductor magnus—a piece of the internal circumflex artery with its veins issuing between the two.

This muscle will assist, though but feebly, the pyriformis and obturators in rotating out the hanging limb; in abducting the bent limb; in balancing the pelvis in standing on both legs, or on one; and in rotating the face to the opposide side when the trunk is supported on one leg.

Hamstrings and *adductor magnus.* The upper ends of the three flexors of the knee-joint (hamstrings) are laid bare at their attachment to the ischial tuberosity: they consist of semitendi-

nosus, L, biceps, N, and semimembranosus, O, and they are more fully seen in Plate LII.

Parts of the origin and insertion of the adductor magnus, which were not visible in the former view of the muscle (Plate XLVII.), are now denuded. Internal to the hamstrings may be seen the origin from the ischial tuberosity ; and external to those muscles is the wide expanded part, which is inserted into the femur in a line with the quadratus femoris, and internal to the attachment of the gluteus maximus.

ARTERIES OF THE BUTTOCK.

Most of the arteries of the buttock belong to the set of external parietal branches of the internal iliac (p. 306): they are the glutcal, sciatic, and pudic, which issue from the pelvis by the great sacro-sciatic notch. Branches of the profunda artery appear also in the lower part of the region dissected.

a. Superficial part of the gluteal artery.
b. Pudic artery.
c. Trunk of the sciatic.
d. Coccygeal branch of the sciatic.
e. Muscular and anastomotic branch of the sciatic.
f. Continuation of the sciatic.
g. Branch to great sciatic nerve.
h. Branch of internal circumflex.
i. Ending of first perforating artery.

The *gluteal artery* comes through the great sacro-sciatic notch above the pyriformis, and supplies the gluteal muscles. It divides at once into a superficial and a deep piece, and the latter of these will be contained in the next Plate.

The superficial part, *a*, sends off many branches to the under surface of the gluteus maximus. One or two small branches run inwards and backwards through the great sacro-sciatic ligament to the integuments, and send deeper offsets to the back of the sacrum and coccyx.

The *pudic artery*, *b*, appears in the buttock for a very short distance : it leaves the pelvis through the great sacro-sciatic notch, below the pyriformis, and then winds over the ischial spine with the nerve of the same name, to enter the perinæum through the small sacro-sciatic notch.

The *sciatic artery*, *c*, escapes with the pudic and sciatic vessels and nerves through the great sacro-sciatic notch, and is accompanied by cutaneous offsets of the small sciatic nerve. It supplies the part of the buttock below the gluteal artery, and furnishes the following branches :—

The *coccygeal branch*, *d*, pierces the great sacro-sciatic ligament, and supplies the gluteus maximus: one of its branches enters that muscle, and accompanies the chief cutaneous offset of the sacral nerves; whilst others ramify on the back of the sacrum and coccyx.

Muscular and anastomotic branch, *e*. This artery varies much in size, and passes transversely outwards to the root of the great trochanter. It supplies largely the gluteus maximus, and ends at the spot mentioned by anastomosing with the gluteal and internal circumflex arteries.

Nerve-branches. A small artery, *g*, enters the trunk of the great sciatic nerve, and is called "comes nervi ischiadici." And the continuation of the artery, *f*, accompanies the smaller sciatic nerve, branching like it to be distributed with the several offsets of the nerve.

Muscular branches, many of which were cut in the dissection, enter the under surface of the great gluteus, and the lower external rotator muscles; and the artery to the quadratus femoris runs to its muscle with the nerve, 5, beneath the gemelli and internal obturator.

The *internal circumflex artery* of the profunda divides into two beneath the quadratus (Plate L.): the branch, *h*, to the thigh issues between the contiguous borders of the quadratus and adductor magnus, and is distributed to the hamstrings.

First perforating artery. This branch of the profunda pierces the adductor magnus, and supplies the gluteus maximus and the biceps muscle, N.

NERVES OF THE BUTTOCK.

Most of the nerves included in this dissection are branches of the sacral plexus, and appear at the lower border of the pyri-

formis, where the plexus ends: they may be arranged into branches to the limb, to the perinæum, and to some external rotator muscles. By the side of the glutcal artery is the superior gluteal nerve, which is not derived from the plexus; and on the great sacro-sciatic ligament lies a branch of the sacral nerves.

1. Cutaneous branch of the sacral nerves.
2. Pudic nerve.
3. Nerve to the obturator internus.
4. Branch to the upper gemellus.
5. Branch to the quadratus femoris.
6. Upper branches to the gluteus maximus.
7. Small sciatic nerve.
8. Lower branches to the gluteus maximus.
9. Inferior pudendal nerve.
10. Cutaneous of the buttock and inner part of the thigh.
11. Great sciatic nerve.
12. Muscular branch of the great sciatic.
13. Superior glutcal nerve.
14. Iliac branch of ilio-hypogastric.

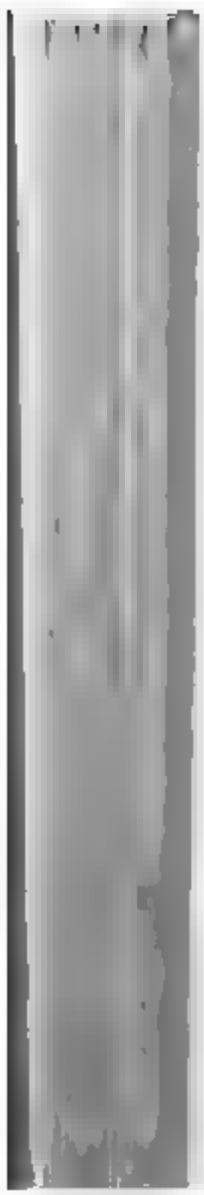
†† Cutaneous of the posterior trunks of the lumbar nerves.

The *small sciatic nerve*, 7, is chiefly a cutaneous nerve of the buttock, scrotum, and back of the limb, for only one muscle (gluteus maximus) receives branches from it. It begins by two or more pieces in the lower part of the sacral plexus, and takes the course of the sciatic artery over some of the external rotators, as far as the lower border of the gluteus maximus: here the nerve furnishes many branches (Plate XLVIII.), and is continued beneath the fascia of the thigh with a branch of artery to the integuments of the calf of the leg. Its offsets are these:—

Muscular or *gluteal* branches, 8, enter the lower part of the gluteus maximus: they are called inferior gluteal, to distinguish them from the branches of the superior gluteal nerve to the smaller glutei muscles.

The *inferior pudendal*, 9, winds beneath the fascia lata, and below the ischial tuberosity, near which it becomes cutaneous to end in the scrotum or the labium (Plate XXXI.).

Cutaneous branches of the *buttock* and *thigh*, 10. The branches of the buttock run backwards over the gluteus maximus, and are better shown in Plate XLVIII. The thigh-branches are inclined downwards and inwards, and piercing the fascia lata, end in the integuments of the upper third of the thigh on the inner aspect.



region of the buttock a branch for the hamstring detached from it, whose distribution will appear in Pl

The *pudic nerve*, 2, turns over the small sacro-scia with the artery of the same name, and gains the pe through the small sacro-sciatic notch. Its further given in the Plates of the perinæum.

Muscular branches of the sacral plexus. supply maximus, and all the external rotators except th externus.

The branches to the gluteus, 6, have been cut ac pierce the muscular fibres: these are known as infe like the branches of the small sciatic to the same penetrate the upper fleshy fibres.

The branch to the obturator internus, 3, accompanie vessels through the small sacro-sciatic notch, and soo the fleshy fibres.

The branch to the upper gemellus, 4, is, as her sometimes ; a considerable difference in its size is man following Plate drawn from another body.

The branch to the inferior gemellus and quadra slender nerve, which runs with a small artery beneath and obturator internus.

ried out as in the preceding Plate, the third stage will be arrived at by removing the gluteus medius, and by cutting through and reflecting the obturator internus and quadratus femoris. On removing a superficial stratum of the great sacro-sciatic ligament the sacral nerves will come into sight.

The small sciatic nerve and the sciatic artery have been cut away ; and all the veins have been removed with the view of rendering the connections less complicated.

DEEP MUSCLES OF THE BUTTOCK.

Two muscles, the gluteus minimus and obturator externus, come under notice for the first time ; but most of the others have been demonstrated in the preceding Plate, though some points in their anatomy receive here further illustration.

A. Cut ends of the gluteus maximus.
B. Insertion of the gluteus medius.
C. Gluteus minimus.
D. Tensor vaginæ femoris.
E. Pyriformis.
F. Upper gemellus.
G. Obturator internus, cut.
H. Lower gemellus.
I. Cut ends of the quadratus femoris.
J. Obturator externus.
K. Insertion of psoas magnus.
L. Insertion of adductor magnus.
N. Vastus externus.
O. Semimembranosus.
P. Biceps cruris (long head).
R. Semitendinosus.
T. Origin of adductor magnus.
U. Great sacro-sciatic ligament.
V. Small sacro-sciatic ligament.

The *gluteus minimus*, C, is somewhat pyramidal in form, and is attached to the hip-bone and femur, like the gluteus medius, beneath which it lies. It arises from the space between the two curved lines on the back of the hip-bone, and extends backwards to the line of union of the iliac and ischial portions of that bone. From this attachment the fibres are directed downwards, converging to a tendon, which is inserted along the fore part of the great trochanter, and blends inferiorly with the tendon of the gluteus medius. Some of the deeper fibres end in the capsule of the hip-joint (Theile).

This muscle is covered by the gluteus medius and pyriformis, and rests on the hip-bone and joint. At the anterior border is placed the tensor of the fascia lata ; and at the hinder edge, the

lower gemellus. On it lie the gluteal vessels, and the superior gluteal nerve.

In its action the muscle resembles the gluteus medius. For if the femur hangs loosely it will be abducted; and the anterior fibres will be able to aid in rotating it in. When the body is supported on both legs this gluteus will act in balancing the pelvis: and when the trunk is rotated on one limb it will bring the face to the same side. At the beginning of a step in walking it advances with the gluteus medius the hindmost leg, and then inclines the pelvis over the supporting femur whilst the swinging limb is put forwards.

Obturator internus and gemelli. On cutting through the obturator, G, and raising the inner end, three or four tendinous pieces, separated by fleshy intervals, will appear on the under surface; and the subjacent bone will be seen to be provided with ridges of fibro-cartilage, which correspond with the fleshy interspaces. A synovial membrane lubricates the surfaces.

Near the pelvis the gemelli muscles, F and H, approach each other beneath the obturator, but near the femur they cover the tendon of the obturator; and all three of them pass beneath the pyriformis to be inserted in front of it into the trochanter and the neck of the femur. In the Drawing the muscles are separated from each other to show the nerve to the quadratus, 8, and its accompanying artery.

The *obturator externus*, J, arises from the outer surface (in part) of the obturator membrane, and from the bone bounding anteriorly the thyroid hole. From this widened attachment the fibres are directed almost horizontally backwards to a tendon, which is inserted into the pit at the root of the trochanter.

At the fore part of the thigh the obturator is covered by the adductors (Plate XXXVII.); and in the second view of the buttock it is concealed by the quadratus femoris, I, except a part of the tendon which is apparent between the upper border of the quadratus and the inferior gemellus (Plate XLIX.). As the muscle passes from the front to the back of the limb it spreads over and supports the lower part of the hip-joint. Escaping beneath its lower border is the internal circumflex artery.

Like the other rotators out, the external obturator draws backwards the great trochanter when the femur hangs loosely; and even when the hip-joint is flexed it will execute the same movement of the thigh-bone, and in this respect it differs in use from the other muscles of its group. When the limbs are fixed as in standing it contributes its share of power in maintaining the pelvis upright on the femur; and in standing on one leg it can direct the face to the opposite side.

Psoas magnus, K. The tendon of this muscle inclines over the hip-joint and the neck of the femur to its insertion into the small trochanter.

The *sacro-sciatic ligaments* connect the back of the hip-bone to the sacrum and coccyx: they are two in number, and are named large and small.

The *large ligament*, U, is wide and thin internally, but thicker and pointed externally. It is attached by its widened inner part to the back of the hip-bone, to the side of the sacrum, and to the side of the coccyx. Its fibres are directed backwards and outwards, and being aggregated together, are inserted into the inner side of the ischial tuberosity and lower border of the hip-bone, blending with the hamstring muscles. It closes below the great sacro-sciatic notch of the pelvis, and gives origin to fibres of the gluteus maximus. Branches of the gluteal and sciatic arteries perforate the ligament, and the offsets of the posterior sacral nerves lie beneath a superficial layer of the fibres.

The *small ligament*, V, unites internally with the larger band, and is attached with it to the side of the sacrum and coccyx. Its constituent fibres are coarse, and pass outwards to be inserted into the ischial spine. By its position it divides into two apertures the space included by the hip-bone and the great ligament.

The upper and larger aperture or notch is bounded above by the hip-bone, and below by the small sacro-sciatic ligament. Through it are transmitted the pyriformis muscle, and vessels and nerves. Above the muscle issues the gluteal artery, *a*, with its veins, and the upper gluteal nerve, 4; and below the muscle come the great and small sciatic nerves, 6 and 12, the pudic nerve, 10, and the sciatic and pudic vessels, *e* and *g*.

The lower and smaller aperture intervenes between the attachments of the two ligaments to the hip-bone, and gives passage to the obturator internus muscle, G, the pudic artery, *g*, with its veins, the pudic nerve, 10, and the nerve to the obturator muscle, 9.

ARTERIES OF THE BUTTOCK.

Parts of the gluteal, sciatic, and pudic arteries of the internal iliac; branches of the internal and external circumflex arteries; and of the first perforating artery of the profunda, are included in the dissection; but the gluteal and internal circumflex will be referred to more especially.

a. Trunk of gluteal.
b. Superficial } of the gluteal.
c, d. Deep branch }
e. Sciatic artery, cut.
f. Coccygeal branches.
g. Pudic artery.
h. Branch of the quadratus.
l. Ending of internal circumflex.
n. Transverse } of the circumflex.
o. Ascending branch }
r. First perforating of the profunda.
s. Branch of perforating to the biceps.
t. Ascending branch of perforating to join circumflex.
†† Branches to the sciatic nerve from the sciatic artery.

The *gluteal artery*, *a*, escapes from the pelvis through the upper part of the great sacro-sciatic notch, as before said, and divides into superficial and deep muscular branches.

The *superficial part*, *b*, appears between the gluteus medius and the pyriformis (Plate XLIX.), and pierces the under surface of the gluteus maximus (p. 387).

The *deep part* divides into two chief branches, which are continued forwards between the gluteus medius and minimus.

One, *c*, courses over the origin of the gluteus minimus to the fore part of the iliac crest, where it anastomoses with the external circumflex of the profunda: it furnishes branches to both the smaller glutei, but chiefly to the medius; and some offsets ascend over the iliac crest to communicate with arteries in the wall of the abdomen.

The other branch, *d*, crosses the middle of the smallest gluteal muscle, and ends in front by supplying the tensor of the fascia lata, and by anastomosing, like the upper branch, with the

external circumflex: its offsets are given to the two muscles between which it lies, but most belong to the smallest gluteus. A considerable branch passes beneath the pyriformis, and penetrates the fibres of the gluteus minimus; some of its ramifications are prolonged to the hip-joint.

The *gluteal veins* have the same anatomy as the artery, and open into the internal iliac vein: they were removed in the dissection.

The *sciatic* and *pudic arteries*, *e* and *g*, have been described with the preceding Plate (p. 387). Several offsets of the sciatic artery, which enter the great sciatic nerve, are marked thus, †.

The *internal circumflex artery* of the profunda, *l*, (p. 376), divides beneath the quadratus into two terminal branches,—ascending and transverse.

The ascending branch, *o*, follows the obturator externus muscle beneath the quadratus femoris to the pit at the root of the great trochanter, and anastomoses there with the gluteal artery; it gives small muscular branches to the quadratus, obturator, and gemelli, and some offsets extend to the surface of the great trochanter.

The transverse branch, *n*, passes back between the borders of the quadratus, I, and adductor magnus, L, and sends branches to the muscles attached to the ischial tuberosity, some small offsets reaching the surface of both the adductor and the great sacro-sciatic ligament, as in the Figure. It anastomoses beneath the hamstrings with the highest muscular branch of the profunda; and with the first perforating artery of the profunda, *r*, by means of a small branch which crosses the upper edge of the adductor magnus near the attachment to the femur, and joins the ascending offset, *t*, from that artery.

External circumflex of the profunda, *i*. The ascending branches of this artery course beneath the tensor of the fascia lata to the hip-bone, where they supply the glutei and the tensor, and anastomose with the gluteal artery. In detaching the gluteus medius the branches to it were cut. Offsets from it are given to the trochanter.

The *first perforating artery* of the profunda, *r*, (p. 377) comes

through the adductor magnus, and ends in the vastus externus: it supplies offsets to the gluteus maximus and the long head of the biceps, and communicates by the branch, *t*, with the internal circumflex.

NERVES OF THE BUTTOCK.

The chief nerves of the buttock appear below the pyriformis, and are derived from the sacral plexus; but above the pyriformis comes the upper gluteal nerve; and on the great sacro-sciatic ligament are sacral nerves.

1, 2, 3. Branches of the posterior sacral nerves.
4, 5. Branches of the superior gluteal nerve.
6. Branches of the small sciatic, cut.
7. Nerve to the upper gemellus.
8. Nerve to the quadratus femoris.
9. Nerve to the obturator internus.
10. Pudic nerve.
12. Great sciatic nerve.
†† Cutaneous branches of the sacral nerves.

Posterior sacral nerves, 1, 2, 3. These are the external branches of the posterior primary trunks of the first three sacral nerves; the highest is marked with number 1, and the lowest with 3. At first they are directed out beneath the multifidus spinæ muscle, and then unite, in the manner shown in the Figure, beneath a thin layer of fibres of the great sacro-sciatic ligament. From this plexiform union of the nerves two or three offsets are continued through the gluteus maximus to the integuments of the buttock (Plate XLVII.). The nerves are not always joined in the manner indicated.

Upper gluteal nerve. Springing from the large lumbo-sacral trunk which connects together the lumbar and sacral plexuses (p. 309), it issues from the pelvis above the pyriformis muscle with the gluteal artery. As soon as it comes into sight it divides, like the artery, into two pieces, which run forwards between the two smaller gluteal muscles.

The upper or more superficial branch, 4, enters the gluteus medius; and the deeper part, 5, furnishes offsets to both the gluteus medius and minimus, and ends anteriorly in the tensor fasciæ latæ.

Branches of the sacral plexus. These nerves have been referred to in the preceding Plate, but some of them are more fully displayed in this deeper dissection.

The *thigh-branches* are the small and large sciatic nerves. The branches of the former have been cut across, and are marked with 6. The larger nerve is pointed out by the number 12.

The *pudic* or *perinæal nerve*, 10, is directed over the small sacro-sciatic ligament to the perinæum, and is accompanied by the pudic artery and the nerve to the obturator internus.

Branches to external rotators. All the external rotators, except the obturator externus, obtain nerves from the sacral plexus. The obturator internus receives the nerve, 9, at its inner or pelvic aspect. The upper gemellus is supplied by a slender nerve, 7, which enters the superficial surface. Two nerves enter the pyriformis at the under surface, but these are not visible until the muscle has been cut and reflected.

The quadratus and inferior gemellus are supplied by the nerve, 8, which passes beneath the upper gemellus and the obturator internus, and pierces the under surface of the quadratus near the upper border. As the nerve crosses under the inferior gemellus it sends an offset to that muscle; and as it lies on the capsule of the hip-joint, fine filaments penetrate that membrane to end in the synovial sac.

DESCRIPTION OF PLATE LI.

THE popliteal space or the ham, with its contents, is delineated in this Figure.

For the dissection of the ham the skin and the deep fascia are to be reflected by a median incision, terminated by a cross cut at each end. The large quantity of fat, which then comes into view, is to be removed with care; for in the deeper regions of the hollow articular vessels and nerves, with other nerves and arteries to muscles, cross through it. On the sides of the artery some lymphatic glands are to be separated from the surrounding fat.

FORM, SIZE, AND BOUNDARIES.

The ham is placed at the back of the knee-joint, and corresponds in the upper limb with the interval in front of the elbow. Like the intermuscular space, which it resembles in the other limb, it is situate on that aspect of the joint to which flexion takes place, and lodges the main vessels and nerves of the limb.

A. Biceps cruris.
B. Semimembranosus.
C. Semitendinosus.
D. Gracilis.
E. Sartorius.
F. Plantaris.
G. Outer head } of the gastrocnemius.
H. Inner head }

In form the popliteal space is lozenge-shaped, with the points directed up and down. Before its lateral boundaries are disturbed it extends about two inches and a half above the knee-joint, and downwards about one inch and a half from the same point; but its length will vary with the degree of separation of the hamstring muscles.

This hollow is produced by the arrangement of the muscles at the knee, for the hamstrings and the heads of the gastrocnemius and the plantaris, as they pass the joint, are collected on the sides of the limb, and give rise thus to the angular intermuscular interval of the popliteal space. By this removal of the muscles from the mid-line of the limb to the sides greater extent of bending is permitted in the joint.

Towards the surface the ham is closed by the teguments, and by the fascia lata strengthened by transverse fibres from the tendons of the hamstrings. In the bottom of the space the floor is formed by the femur and the knee-joint.

Laterally it is inclosed by the intermuscular septa, which are inserted into the condyloid lines of the femur, and by the following muscles. On the outer side lies the biceps muscle, A, as low as the condyle of the femur: and below that point come the plantaris, F, and outer head of the gastrocnemius, G. On the inner side it is limited as far as the condyle by the semimembranosus, B, by the semitendinosus, C, lying on the other, and by the sartorius and gracilis, D and E, which intervene between the

semimembranosus and the femur; and below the condyle is situate the inner head of the gastrocnemius, H.

The upper and lower points or angles are constructed also by muscles. At the upper, the biceps, A, and semitendinosus, C, are in contact; and at the lower, the inner head of the gastrocnemius, H, comes into apposition with the plantaris and the outer head of the gastrocnemius, F and G.

The depth of the space is greater above, than below the knee-joint, and is greatest opposite the inter-condyloid hollow of the femur. The widest part is on a level with the condyle of the femur.

The ham is closed on all sides except above and below, and at those spots it communicates with the back of the thigh and leg. Above, a probe can be pushed under the hamstrings along the course of the internal popliteal nerve; and below it can be passed under the gastrocnemius by the side of the great blood-vessels. Blood poured out from the vessels into the hollow would diffuse itself under the muscles of the thigh and leg in the channels indicated.

In the popliteal space are contained the large blood-vessels and nerves of the limb, with their branches; also a branch of the obturator nerve; another of the small sciatic nerve with its artery; and lymphatics, with much fat.

VESSELS OF THE HAM.

The chief vessels in the ham are the popliteal artery and vein, which wind from the fore part to the back of the limb above the knee, so as to pass the knee-joint on the flexion-side; but branches of those trunks cross the space, and a small superficial artery, accompanying the small sciatic nerve, is continued through it to the leg.

a. Popliteal artery.
b. Upper external articular.
c. Upper internal articular.
d. Cutaneous branches with veins.
e. Cutaneous branch with the small sciatic.
f. Cutaneous branch of the anastomotic.
g. Internal sural to gastrocnemius.
h. Short saphenous vein.
i. Cutaneous veins of the back of the leg.
l. Popliteal vein.
n. External sural artery to the gastrocnemius.

The *popliteal artery*, *a*, begins and ends beyond the limits of the space now defined. The part of the artery contained in the ham courses obliquely from the inner side above to the mid-point of the space below. At first it issues from beneath the semimembranosus, B, but it lies afterwards in the hollow between the condyles of the femur and the heads of the gastrocnemius. It is deeply placed throughout, and rests on the lower end of the femur and the knee-joint. Internally it is in contact with the semimembranosus, B, and with the inner head of the gastrocnemius, H; and the first muscle would serve as the guide to the position of the vessel. It has the following connections with veins and nerves:

The popliteal vein, *l*, is closely united to the artery throughout. At the upper end of the space it is external to the arterial trunk, whilst towards the lower end, or between the heads of the gastrocnemius, it becomes superficial to that vessel. Some small cutaneous veins, *i*, cross the inner side of the artery in their course to join the popliteal vein.

The internal popliteal nerve, 3, passes through the ham from the upper to the lower angle, and is much more superficial than the blood-vessels. At first it lies outside the line of the vascular trunks, but is placed over these between the heads of the gastrocnemius. Some of its branches touch the vessels: for instance the short saphenous nerve, 4, lies on the popliteal trunks below, and the nerve, 6, to the inner head of the gastrocnemius crosses them; further the azygos articular nerve, 7, enters the back of the joint beneath the vessels.

Much more superficial than the internal popliteal trunk, 3, is the continuation of the small sciatic nerve, 2, with an accompanying vessel; and resting on the popliteal artery is the obturator nerve.

Branches of the artery. In the popliteal space the artery furnishes muscular and articular branches.

Muscular branches. These are supplied from the upper and lower parts of the trunk. The upper enter the biceps and semimembranosus; and the lower or sural, *g* and *n*, are distributed to the heads of the gastrocnemius and the plantaris.

Articular arteries. Only the upper pair is visible, and it is attached to the arterial trunk rather above the knee-joint. The outer one, *b*, crosses the femur above the condyle, and passing under the biceps, leaves the ham by perforating the external intermuscular septum. The inner, *c*, is directed beneath the inner hamstrings and the tendon of the adductor magnus to the front of the knee-joint.

A single median (azygos) articular branch enters the joint through the posterior ligament, but it is concealed by the trunks of the vessels.

NERVES OF THE SPACE.

In the ham are lodged the two great trunks into which the sciatic nerve splits, with branches of these; and in it are offsets of the small sciatic and obturator nerves.

1. Internal cutaneous of the thigh.
2. Small sciatic nerve.
3. Internal popliteal nerve.
4. Short saphenous nerve.
5, 6. Branches to the heads of the gastrocnemius.
7. Middle articular branch.
8. External articular branch.
9. Communicating peroneal branch.
10. External cutaneous of the leg.
11. External popliteal nerve.

Popliteal nerves. At the back of the thigh the sciatic nerve divides into the internal and external popliteal trunks (Plate LII.); these are continued through the ham to the leg, and furnish branches to the surrounding parts.

The internal or larger trunk, 3, lies nearly in the middle of the limb, and takes the position before said to the blood-vessels (p. 400): it gives articular branches to the knee-joint; muscular to the gastrocnemius, plantaris, and soleus; and a cutaneous nerve (short saphenous) to the back and outer part of the leg.

The external popliteal, 11, is placed under cover of the biceps muscle, and leaves the space below to reach the fore part of the leg. Near its commencement it gives an articular nerve, 8, to the knee-joint; and whilst it is contained in the space two or three cutaneous nerves to the back and outer part of the leg arise from it. No muscles receive branches from this trunk.

The small sciatic nerve, 2, is continued through the popliteal space, immediately beneath the fascia lata, to end in the lower part of the back of the leg (Plate LIII.).

The obturator nerve crosses along the popliteal artery to reach the knee-joint, to which it is distributed: it is more fully seen in the following Plate.

Lymphatics. Large lymphatic vessels with some glands lie along the blood-vessels. The glands are three or four in number, and through them pass the lymphatics accompanying the tibial blood-vessels and the short saphenous vein.

Fat in the ham. A loose granular fat, similar to that in the ischio-rectal fossa, fills the popliteal space, and surrounds loosely the vessels and nerves, so as to permit their necessary displacement in the movements of the knee-joint. Above and below it is continuous with the areolar tissue and fat of the thigh and leg. Abscesses form readily in it, and may acquire large size without giving rise either to swelling on the surface, or to fluctuation. From the strength and completeness of the subcutaneous boundary the pus does not find its way readily to the surface; and to prevent this fluid burrowing upwards and downwards under the muscles, where the popliteal space is not closed by fascia, incisions should be made through the fascia lata.

DESCRIPTION OF PLATE LII.

In this Figure a view of the dissection of the back of the thigh is given.

After the popliteal space has been examined, the hinder part of the thigh may be exposed by slitting up and reflecting the skin and the fascia between the ham and the buttock. The surface of the muscles having been cleaned, these may be separated from each other to trace the vessels and nerves.

MUSCLES OF THE BACK OF THE THIGH.

Behind the femur are situate the flexor muscles of the hip-joint, which are called commonly the hamstrings. At this stage of the dissection the insertion of the gluteus maximus can be better seen than in Plate XLVIII., where the muscle is delineated.

A. B. C. Insertion of the gluteus maximus.
D. Quadratus femoris.
E. F. Insertion of the adductor magnus.
G. Long head of the biceps.
H. Short head of the biceps.
I. Ischial part of the adductor magnus.
J. Semitendinosus.
K. Semimembranosus.
L. Outer head of the gastrocnemius.
N. Inner head of the gastrocnemius.

Insertion of the gluteus maximus. The fibres of this muscle are inserted partly into the fascia lata, and partly into the femur. About the upper two thirds of the whole (as far as A) end in the fascia lata. The remaining fibres are inserted by two parts;—one, B, the larger, is fixed into the line leading from the linea aspera to the great trochanter; and the other, C, ends in the fascia lata.

Biceps flexor cruris. The muscle consists of two heads, long and short.

The long head, G, is spindle-shaped, and arises from the lower part of the ischial tuberosity in common with the semitendinosus. The short head, H, which is flattened, takes origin from the linea aspera, and from nearly the whole of the outer condyloid line of the femur, as well as from the external intermuscular septum. Both heads blend below in a tendon, which is divided into two pieces by the external lateral ligament of the knee-joint, and is inserted into the head of the fibula, whilst a small part is prolonged to the head of the tibia: from the tendon a process is continued to the fascia of the leg.

Uncovered by muscle except above, where the gluteus maximus conceals it, the biceps lies on the adductor magnus, and crosses the great sciatic nerve. To its inner side is the semitendinosus, J.

In the lower fourth of the thigh it bounds externally the hollow of the ham, and forms the outer hamstring. Between the external lateral ligament of the knee-joint and the tendon of insertion a synovial bursa intervenes.

When the tibia is free to move the muscle combines with the other hamstrings in drawing backwards that bone and flexing the knee; and after the joint has been bent it will rotate outwards the leg. If the bones of the leg are fixed, it will assist its fellows in propping the pelvis on the femur; and if the lower limb is moveable at the hip, but immoveable at the knee-joint, the muscle will bring down and back the raised femur, thus checking flexion of the hip, and will help in putting back the forward leg in the process of walking backwards.

The *semitendinosus*, J, is named from its long tapering tendon near the knee. It arises from the ischial tuberosity and the tendon of the biceps. Its fibres form at first a flat muscle; but this becomes round below, and ends at the lower third of the thigh in a tendon, which is inserted into the inner side of the tibia close below the gracilis (Plate XLVII.).

Like the other hamstrings, it is covered above by the gluteus maximus; and it rests on the semimembranosus. To its outer side is the biceps as far as the popliteal space. At the insertion a synovial membrane envelops the tendon; and under the muscle at its origin is placed another bursa (Theile). A tendinous line crosses the muscle obliquely from the inner to the outer side, so as to divide it into an upper and a lower part, but some of the under fibres pass over this intersecting band.

Acting from the pelvis the muscle bends the knee-joint; and it will afterwards rotate in the leg. The leg being fixed and the hip-joint free to move, the muscle balances the pelvis. It will put back the raised femur in the same way as the biceps.

The *semimembranosus*, K, is the largest of the hamstrings, and arises by a tendon from the ischial tuberosity, external to and rather above the other two muscles. From this tendon which widens and becomes thin at the inner edge, but is thickened and rounded at the outer, the fleshy fibres spring, and form below a rounded belly. Inferiorly the muscle is terminated by a second

tendon, which is inserted into a groove on the inner tuberosity of the head of the tibia, and sends off the three following fibrous processes :—one backwards to join the capsule of the knee-joint ; another forwards to blend with the internal lateral ligament of that joint ; and a third downwards to unite with the fascia covering the popliteus muscle. At the insertion a small bursa is interposed between the tendon and the bone.

Crossing beneath the other hamstrings it is hollowed out above to lodge the semitendinosus. Beneath it is the adductor magnus. In the lower third of the thigh it bounds internally the ham, and projects into that hollow so as to cover the popliteal vessels. Between its lower tendon and the inner head of the gastrocnemius is a large bursa, which contains oftentimes a thick glairy reddish fluid.

Being stronger than the semitendinosus it acts more powerfully in bending the knee-joint, and in rotating inwards the leg, supposing the tibia to be the part moved. In the standing posture the pelvis is propped by it and the other hamstrings. In attempts to flex the hip-joint, whilst the knee is kept extended, it is used to check the elevation of the femur. In concert with its fellows it will depress and move back the femur, as in walking backwards. After the body has been bent forwards, as in stooping, the muscle will draw down and back the ischial tuberosity, and place the pelvis in the erect position.

Adductor magnus. This large fleshy muscle separates the hamstrings, and the nerves and vessels at the back of the thigh, from the femoral vessels and the other adductor muscles. Near the attachment to the lower end of the linea aspera the femoral vessels pass from before back through an aperture in it, which is fleshy behind but tendinous in front : this hole is bounded externally by the slip, F, which is fixed for a short distance to the inner condyloid line, and internally by the strong fibres, I, coming from the ischial tuberosity and ending in a tendon to the inner condyle of the femur.

VESSELS OF THE BACK OF THE THIGH.

Many branches of the profunda pierce the adductor magnus,

[redacted]

[redacted] Plate III.: [redacted] Plate III.

Branches of the profunda. Most of the branches of the profunda, viz., perforating and muscular, are directed to the back of the thigh through the adductor magnus, and ramify in the hamstrings: one, internal circumflex, runs above the adductor.

Internal circumflex, c. The transverse branch of this artery passes between the edges of the quadratus femoris, D, and adductor magnus, I, and supplies the hamstring muscles (p. 305).

The *perforating arteries* are four in number, and are derived from the profunda on the front of the thigh (p. 377). All of them pierce the adductor magnus near its attachment to the femur, the first appearing near the top of the muscle, and the last near the lower end of the linea aspera; and all, except the first, are more or less concealed by the biceps. The first is marked with *d*, the second with *e*, and the cutaneous part of the third with, *f*: they have the following distribution:—

Each (except the first) is directed outwards close to the linea aspera, and through the short head of the biceps and the external

intermuscular septum to the vastus externus muscle, in which it is distributed, maintaining communications with its fellows and with the descending branches of the external circumflex artery. In the first artery, *d*, of the set there is a difference in its course, for it is higher than the short head of the biceps, and pierces the gluteus maximus. In its passage each furnishes a branch to the long head of the biceps, except the fourth when it is small; and as each artery pierces the short head of the biceps it gives a small offset to that muscle.

A *cutaneous branch* is given off from each of the three first; and this enters the fat along the line of the intermuscular septum.

Muscular or *anastomotic branches* of the profunda. These are distinct from the perforating arteries (p. 377), and pierce the adductor magnus internal to those vessels. Generally four in number, most of them are concealed by the inner hamstrings, but the two which are visible in the Figure are marked with *g*.

The highest is placed outside the line of the others, and appears about five inches from the ischial tuberosity: it supplies the semitendinosus and biceps, and anastomoses with the internal circumflex. The remaining three come out in a line through a cleft between the fibres of the adductor, and about two inches from each other: they end mostly in the semimembranosus, but one or more may give offsets also to the biceps and semitendinosus, as is the case with the lowest in this Plate. Offsets are furnished from them to the great sciatic nerve.

These vessels serve the purpose of maintaining at the back of the thigh communications in the hamstring muscles with branches of the popliteal artery.

Near the inner border of the adductor magnus some small *cutaneous branches* issue from the muscular fibres to end in the integuments.

The *popliteal artery*, *i*, continues the femoral trunk from the front to the back of the limb, and is represented in the upper limb by the lower part of the brachial artery. Named from its position in the popliteal space, it extends from the opening in the adductor magnus to the lower border of the popliteus muscle,

where it divides into two—anterior and posterior tibial arteries. As its connections in the lower part of the thigh differ greatly from those in the leg it may be divided into two parts for the purposes of description.

The upper and longer part, *i*, reaches to the knee-joint, and is contained in the popliteal space. It is placed deeply in the upper part of the ham, but it becomes more superficial below in consequence of the projection backwards of the femur, and the decreasing thickness of the limb. Its direction is oblique from the inner side of the femur to the middle of the joint. At first it is overlapped by the semimembranosus, K, as far as the condyles of the femur, but thence to the joint it is covered by the teguments, the fascia lata, and the fat, and by veins and nerves. Beneath the vessel, from above down, are placed the lower end of the femur, and the posterior ligament of the knee-joint. Above the condyles of the femur the artery is nearer the inner than the outer side of the space; and beyond that point it lies between, and close to the heads of the gastrocnemius L and N with the plantaris.

The popliteal vein, *o*, is closely united to the artery throughout, but it changes its position in the following way:—as far as the condyles of the femur the vein is superficial and external, so as to leave only a narrow arterial strip visible internally, but onwards to the joint the vein covers the artery. Over the artery between the heads of the gastrocnemius lie the short saphenous vein, and cutaneous and muscular branches of arteries, veins, and nerves.

Two nerves accompany the artery, viz. the internal popliteal and the obturator. The popliteal trunk passes vertically along the middle of the limb, from the upper to the lower point of the ham, and lies external to, and much more superficial than the bloodvessels; but between the condyles of the femur it is brought much nearer to the vessels, and lower down, between the heads of the gastrocnemius, it is placed over the artery and vein. Some of the branches of this large trunk come into contact with the artery:—thus the posterior articular nerve to the joint, 2, crosses under the artery; and the short saphenous nerve, 4, lies over the

bloodvessel in the interval between the heads of the gastrocnemius. The obturator nerve, 1, runs on the artery as far as the knee-joint, in which it ends.

From this part of the arterial trunk muscular and articular arteries are supplied, the former coming off near the top of the ham, and the latter near the knee-joint. All are so small in size as not to disturb the reparative process which would be set up in the parent trunk after a ligature has been applied to it.

Peculiarities. Very few variations in the course and condition of the artery, and in the surrounding parts are met with. Perhaps the most noteworthy change in the artery is its bifurcation into the two tibials opposite the knee-joint, instead of below that articulation.

The position of the companion vein to the artery is inconstant, at one time covering more of that bloodvessel than at another; and not very unfrequently the vein and artery change places.

Ligature. Should circumstances render ligature of the popliteal artery necessary, the spot best suited for its application would be about an inch above the condyles of the femur, where there are only small collateral branches, and where the connections are not complicated. The surface guide for the first incision will be the line of direction of the artery, and the vessel will be arrived at by cutting vertically down through the fat towards the femur. The depth of the vessel may be diminished during an operation by bending the knee so as to relax the sides of the ham. On attempting to separate the vein from the artery it should be remembered that the two are very closely united together, and that sometimes the artery is external to the vein.

Compression. Whilst the popliteal artery is contained in the intermuscular space behind the knee pressure can be applied to impede the current of the circulating fluid. Bending the knee too, so as to make the calf of the leg touch the back of the thigh, will compress to a certain extent the artery, and will control the circulation of the blood in it; and this kind of pressure has been employed with success in later times in the treatment of aneurism of the popliteal artery.

Branches of this part of the artery. These consist of muscular and articular, as before said.

Upper muscular branches. Three or four in number they spring from the popliteal trunk soon after it enters the ham: they supply the semimembranosus and biceps, but most enter the former muscle; and in those muscles they communicate with the perforating and muscular branches of the profunda.

The *articular arteries* ramify over, and in the knee-joint. They are five in number, viz. an upper and a lower pair, with a single central branch, but only the upper pair comes into this dissection.

The upper pair of articular branches leave the sides of the parent trunk, and are directed over the femur to the front of the limb. The *external, k*, passes beneath the biceps, and the *internal, l*, beneath the adductor magnus and the other muscles bounding internally the ham; on the fore part of the joint they end in muscular branches to the triceps, and in anastomotic branches over the joint.

The *middle* or *azygos* artery penetrates into the joint through the posterior ligament; it is concealed by the large popliteal nerve.

The *popliteal vein, o*, has the same extent, and the same connections with surrounding parts as the artery, but its position to that vessel changes. Between the heads of the gastrocnemius it conceals entirely the artery, but higher up the artery becomes more and more uncovered, and at the opening in the adductor magnus the vein is quite external.

Its contributing branches are muscular and articular, corresponding with those of the artery; and it receives in addition the short saphenous vein, *p*, opposite the back of the joint.

NERVES OF THE BACK OF THE THIGH.

The great sciatic nerve and its two primary popliteal branches are continued along the back of the thigh to the leg. At the buttock the ramifications of the small sciatic nerve come into sight.

1. Obturator nerve.
2. Posterior articular of the knee.
3. External articular of the knee.
4. Short saphenous.
5. Branches to the gastrocnemius.
6. Branch to the soleus muscle.
7. Peroneal communicating branch.
8. Nerve to short head of the biceps.

{ 9. Branch to adductor magnus.
{ † A second branch to the adductor.

10. Muscular branch to the hamstrings.
11. Great sciatic nerve.
12. Internal popliteal trunk.
13. External popliteal trunk.
14. Small sciatic nerve.
15. Inferior hæmorrhoidal nerve.
16. Inferior pudendal nerve.

The *great sciatic nerve*, 11, takes origin in the sacral plexus (p. 310); and after passing the buttock, it is continued along the back of the thigh as far as midway between the hip and knee-joints, where it bifurcates into internal and external popliteal. In this course the nerve is covered above by the gluteus maximus, and thence by the biceps, so that it is not superficial in any part. It rests on the adductor magnus, and lies along the outer side of the semimembranosus. The point of splitting of the nerve reaches sometimes nearer the knee; at others it takes place close to the origin from the sacral plexus, one piece piercing the fibres of the pyriformis muscle.

Its *branches* are furnished to the neighbouring muscles, viz. to the hamstrings and the great adductor.

The *branch to the hamstrings*, 10, leaves the upper part of the trunk in the thigh, and subdivides into pieces which enter the semitendinosus, semimembranosus, and the heads of the biceps. Occasionally some of the offsets arise as separate branches from the nerve-trunk.

Branch to the adductor magnus, 9. This springs from the great sciatic below the others, and sinks into the fleshy fibres about the middle of the muscle; but it is small in comparison with the size of the adductor, because the muscle is supplied mainly by the obturator nerve (p. 378). A second nerve, †, penetrates the fibres near the inner border.

The *internal popliteal nerve*, 12, is the larger of the two trunks derived from the great sciatic, and is directed to the back of the leg. It is continued through the middle of the ham, and retains the name popliteal as far as the lower border of the popliteus.

At the upper part of the ham it is placed outside the line of the bloodvessels, but it gradually approaches these near the knee, and conceals them at the lower point of the space. Its offsets are furnished to the knee-joint, and to the teguments and some muscles of the back of the leg: most of them are now seen at their origin.

Articular branches. The posterior, 2, arises near the top of the ham, and runs beneath the trunk of the nerve and the popliteal vessels to the back of the knee-joint: piercing the posterior ligament, it ends in the synovial membrane.

Another nerve, lower internal, (Plate LIV.) united with the preceding or leaving the trunk below it, passes under the trunks of the bloodvessels, and accompanies the lower internal articular artery to the joint.

Branches of the gastrocnemius, 5. Each head of the muscle receives a separate nerve, and the branch to the outer head supplies an offset to the plantaris muscle.

Branch to the soleus, 6. A rather large nerve, it passes under the gastrocnemius, and enters the top of the soleus (Plate LIV.).

The *short saphenous*, 4, is a nerve for the teguments: lying on the popliteal trunk it courses over the gastrocnemius, to become cutaneous below the calf of the leg (Plate LIII.).

The *external popliteal trunk*, 13, whilst contained in the ham lies under cover of the biceps muscle; but it leaves the space opposite the level of the knee-joint, and proceeds behind the tendon of the same muscle to a point below the head of the fibula, where it ends in branches for the front of the leg. In the part of its course beyond the space it is very superficial, resting on the gastrocnemius and soleus, and being covered by the integuments and fascia of the limb: here the nerve may be struck by a blow or injured by a wound: whilst higher up it is protected by the overhanging biceps, which will serve also as a guide to its position.

No muscular branch is furnished to the back of the leg, but like the other popliteal trunk it gives an articular offset to the knee, and cutaneous to the back of the leg.

The *external articular branch*, 3, leaves the parent trunk high

up in the popliteal space, and descends under cover of the biceps muscle nearly to the condyle of the femur; at this spot it meets the upper external articular artery, and accompanying this to the outer side of the knee divides into two pieces for the joint.

The *peroneal communicating branch*, 7, is very variable in size, and pierces the deep fascia near the upper part of the calf of the leg: to the integuments it distributes offsets, and joins the short saphenous nerve (Plate LIII.).

Obturator nerve, 1. The articular branch of this nerve begins on the fore part of the thigh (Plate XLVII.), and reaches the ham by perforating the adductor magnus near the opening for the femoral vessels. It is then directed along the popliteal vein and artery, supplying offsets to them, as far as the intercondyloid hollow of the femur; here it quits the artery on the inner side, and enters the joint by piercing the posterior ligament.

Small sciatic nerve, 14. In the first two Plates of the dissection of the buttock this nerve has been more completely depicted than in this Figure. The origin and separation of the branches at the lower border of the gluteus maximus are visible, but most of the limb-branches have been cut through near their beginning.

DESCRIPTION OF PLATE LIII.

THE cutaneous vessels and nerves, and the superficial muscle of the back of the leg, are represented in this Illustration.

The skin is to be reflected by means of a median longitudinal incision along the back of the leg, from four inches above the knee-joint to the sole of the foot, with a transverse cut at each end of it. In the fat which then appears the superficial nerves and vessels may be found in the situations pointed out in the Figure; though the short saphenous nerve does not come through the deep fascia till half way along the leg.

CUTANEOUS NERVES OF THE BACK OF THE LEG.

The tegumentary nerve-branches on the back of the leg are derived from the popliteal trunks, and from the small sciatic and anterior crural nerves.

1. Inner branch of the internal cutaneous of the thigh.
2. Internal or long saphenous.
3. Small sciatic.
4. External or short saphenous.
5. Peroneal communicating branch.
6. Cutaneous branch of the outer part of the leg.
7. Internal popliteal trunk.
8. External popliteal trunk.

Internal cutaneous of the thigh. The inner branch of this nerve, 1, becomes cutaneous close above the knee-joint, and descending over the inner belly of the gastrocnemius, reaches about half way to the heel. Near the knee it is joined by a small branch from the internal saphenous.

Internal or *long saphenous nerve*, 2, escapes from beneath the sartorius on the inside of the knee; piercing then the deep fascia, it enters the subcutaneous fatty layer, and accompanies the vein of the same name to the inner side of the foot. A small communicating branch unites it and the internal cutaneous.

The *small sciatic nerve*, 3, passing through the ham, pierces the deep fascia below that space. When cutaneous, it is applied to the short saphenous vein, and sending offsets around the vessel, is continued to the middle, or the lower third of the leg. Inferiorly it unites with an offset of the short saphenous nerve.

The *external* or *short saphenous nerve*, 4, coming from the internal popliteal trunk (p. 412) courses along the back of the leg and below the outer ankle, with the vein of the same name, to the outer side of the foot and little toe. In this course it lies beneath the deep fascia till about half way down the leg, where it enters the fat, and is joined by the peroneal communicating branch, 5. It distributes offsets to the integuments of the leg below the calf, and many branches of large size to the outer side of the heel and foot.

The *peroneal communicating branch*, 5, is derived from the

external popliteal trunk: appearing superficial to the fascia, it joins the short saphenous as soon as this becomes cutaneous. To the outer side of the leg it furnishes a considerable cutaneous branch, 6, which reaches two thirds or more of the distance to the heel: this nerve may arise separately from the external popliteal trunk.

One or two other cutaneous nerves for the upper and outer part of the leg are supplied by the trunk of the popliteal nerve.

SUPERFICIAL VESSELS OF THE BACK OF THE LEG.

Both cutaneous arteries and veins are found with the cutaneous nerves at the back of the leg.

Arteries.	Veins.
a. Trunk of the popliteal.	*g.* Trunk of the popliteal.
b. Muscular branch of popliteal.	*h.* Internal or long saphenous.
c. Cutaneous branch with short saphenous nerve.	*i.* External or short saphenous.
d. Cutaneous branch with peroneal communicating nerve.	*j.* Communicating branch between saphenous veins.
e. Cutaneous part of the anastomotic artery.	*k.* Communicating to saphenous from posterior tibial.

Cutaneous arteries. Many of these perforate the deep fascia at intervals, and some pierce the gastrocnemius; but the longest and largest accompany the superficial veins.

The *branch, c,* with the *short saphenous nerve* springs from the popliteal trunk near the knee-joint, and accompanies the vein beneath the fascia to reach the integuments below.

The *branch, d,* with the *peroneal communicating nerve,* begins in a muscular branch of the popliteal trunk, and runs with an offset of the nerve to the integuments of the outer part of the calf.

A *branch* with the *small sciatic nerve* is supplied from the muscular artery, *b,* and reaches the integuments below the upper third of the leg.

The *cutaneous branch, e,* of the *anastomotic* appears at the knee; it escapes from beneath the sartorius, and is continued onwards with the internal saphenous nerve.

Superficial veins. Two in number, and named saphenous, they begin on the dorsum of the foot—one on the outer, and the other on the inner side.

The *internal saphenous, h*, the larger of the two, appears only for a short distance on the inner side of the knee and calf of the leg. Upwards it is prolonged to the thigh, and downwards it is continued to the foot with the nerve of the same name. At the knee it is joined by branches from the deep veins.

The *external* or *short saphenous, i*, begins on the outer side of the foot in the venous arch on the dorsum (Plate LVI.). Bending below the outer ankle, it ascends in the teguments along the outer border of the tendo Achillis, and the middle line of the calf of the leg to the popliteal space, where it ends by joining the popliteal vein. In the lower half of the leg it lies with the short saphenous nerve, and in the upper half with the small sciatic nerve. About the foot and heel it receives many branches both superficial and deep ; higher in the leg it is joined by branches from the teguments and deeper parts, and communicates with the internal saphenous vein—one of the last set of branches being marked with *j*.

MUSCLES OF THE BACK OF THE LEG.

The superficial layer of muscles, forming the projection of the calf, is delineated in this and the following Plate. In the Illustration a view of the undisturbed condition of the popliteal space is also obtained.

A. Biceps cruris.
B. Semimembranosus.
C. Semitendinosus.
D. Sartorius.
F. Inner head of the gastrocnemius.
G. Plantaris, belly of the muscle.
H. Outer head of gastrocnemius.
I. Tendon of the plantaris.
J. Soleus muscle.
K. Tendo Achillis.

Popliteal space. In this Figure the intermuscular hollow is represented as it appears in form and size before the lateral boundaries are disturbed. In Plate LI. the space is shown as it is usually described.

As now seen the ham measures about three inches in length, and one and a half in width at the widest part ; and its diminished size is due to the greater approximation of the biceps, A, and semimembranosus, B, over the hollow. Like the axilla, the space extends largely under the muscles though it has but a comparatively small surface opening ; and it is prolonged upwards between the femur and the hamstrings. Tumours in the space, projecting under the muscles bounding laterally the ham, would not be recognised with facility in consequence of the coverings over them.

Vessels. In the undisturbed state of the ham the popliteal vessels are laid bare only for a very short distance. About an inch of the *popliteal artery, a,* is visible—the part opposite the condyle of the femur, which comes from beneath the semimembranosus, and disappears under the inner head of the gastrocnemius.

A muscular branch, *b,* leaves the trunk of the artery here, and supplies the biceps and semimembranosus : this furnishes a cutaneous offset with the small sciatic nerve.

About two inches of the *popliteal vein,* can be seen lying external to and in contact with the artery : at this spot the short saphenous vein opens into it.

Nerves. Very unequal parts of the popliteal nerves appear in the hollow of the ham before the muscles are drawn apart from each other. About three inches of the internal popliteal trunk is uncovered ; but strictly speaking only an inch of the external popliteal, for the greater part of the nerve here delineated lies out of the ham, and rests on the gastrocnemius and soleus muscles.

Muscles of the calf of the leg. Three muscles form the calf of the leg, viz., gastrocnemius, soleus, and plantaris, but only the first is illustrated in this Figure.

The *gastrocnemius,* the most superficial of the muscles of the calf, consists of two halves or bellies, F and H, which unite below in a common tendon.

The inner half of the muscle is attached above by tendon to the posterior part of the inner condyle of the femur, and by

fleshy fibres to the condyloid line for about an inch. And the outer belly is fixed also by tendon to the outer condyle of the femur, viz. to the upper and hinder part, but chiefly to an impression on the outer surface. Fleshy fibres soon succeed to each tendon of attachment, and descend, forming separate bellies (inner and outer), to end in the wide common tendon.

The common tendon, broad and thin above, where it receives the gastrocnemius, becomes narrowed below, and joins that of the soleus in the tendo Achillis, K: from it a narrow piece is prolonged upwards between the halves of the muscle.

The muscle is in contact by one surface with the fascia of the leg; and by the other with the soleus and plantaris, and the popliteal vessels and the internal popliteal nerve. The inner half or belly is more prominent than the outer, and reaches lower down the leg. At its origin the two parts of the muscle limit laterally the popliteal space.

In its action on the ankle the muscle is always combined with the soleus through the tendo Achillis. But from its attachment to the femur it possesses a power of moving that bone, which is not shared by the soleus. Supposing the foot fixed, the gastrocnemius can draw back and down the femur, bending the knee-joint at the same time, as is exemplified in stooping to the ground, or in squatting. In walking backwards it will assist the soleus, the knee-joint being kept straight by the extensors, in bringing the limb over the projected foot.

DESCRIPTION OF PLATE LIV.

THE soleus and plantaris muscles, and the lower part of the popliteal vessels and nerves, are laid bare in this view.

On cutting through the heads of the gastrocnemius opposite the knee-joint, and removing that muscle as far as the common

tendon, the subjacent muscles, vessels, and nerves, will be displayed as soon as the fat and areolar tissue have been removed.

MUSCLES OF THE CALF OF THE LEG.

The deeper muscles of the calf, viz., the soleus and plantaris, cover the bones of the leg; and above these, at the back of the knee-joint, lies the popliteus—one of the deep layer of muscles.

A. Biceps cruris.
B. Semimembranosus.
C. Semitendinosus.
D. Sartorius.
F. Inner head of gastrocnemius.
G. Plantaris.
H. Outer head of gastrocnemius.
I. Popliteus.
J. Soleus.
K. Tendo Achillis.

The *plantaris*, G, possesses a short rounded belly, from three to four inches long, and a narrow, slender tendon, the longest in the body. The muscle arises by fleshy fibres from the outer condyloid ridge of the femur, above the attachment of the outer head of the gastrocnemius. Opposite the upper edge of the soleus the fibres end in the tendon, which is prolonged between the gastrocnemius and soleus and along the tendo Achillis, to be inserted into the back of the os calcis at the inner side of, or with that tendon.

At its origin the muscle appears inside the external head of the gastrocnemius, and forms part of the outer boundary of the popliteal space. As far as half way down the leg it is covered by the gastrocnemius; but where this muscle ends in a tendon the plantaris becomes cutaneous, and then lies along the inner border of the tendo Achillis.

Its action though slight is similar to that of the gastrocnemius, for if the foot is unsupported it will extend the ankle; or, the foot being fixed, it will help to bend the knee, as in stooping.

The *soleus*, J, the deepest muscle of the calf, is named from its flattened and widened form. It is attached to both bones of the leg, viz., to the head and upper third (sometimes half) of the posterior surface of the fibula, to the oblique line across the posterior surface of the tibia, as well as to the middle third of

the hinder border of this bone. And between the two bones is connected with a tendinous band, which bridges over t popliteal vessels and nerves. About midway between the kn and the heel the fleshy fibres end in a tendon which blends wi that of the gastrocnemius.

On the cutaneous surface rest the plantaris and gastrocnemiu and underneath the soleus are the deep muscles of the leg, wi the main blood-vessels and nerve of the limb. The fibul attachment is thick and fleshy, and the tibial, thinner than t other, is aponeurotic on the under surface (Plate LV.). Paral to the upper border is the popliteus muscle, I.

The *Tendo Achillis*, K, is formed by the union of the apone roses of the gastrocnemius and soleus about half way down t leg. At its upper end it measures about three inches in widt and is thin, but it gradually tapers downwards, becoming thick and rounded near the heel; and finally it is inserted by a sou what widened part into the lower half of the posterior surfa of the os calcis. In Plate LV. a bursa is shown, separating t tendon from the upper part of the bone. Comparatively sup ficial throughout, it is covered only by the teguments and t deep fascia; and along the outer side, below, are placed the sh saphenous vein and nerve.

In deformity of the foot with elevation of the heel, divisi of the tendon is needful to allow the os calcis to be put in conta with the ground. In the execution of this operation the cutti instrument is entered beneath the tendon about an inch abo the heel, and on the inner side; and the tendon being put on tl stretch by forcible flexion of the ankle, the knife is carri outwards through it, with a sawing movement, care being take not to divide the integuments as the last parts of the tendon a cut through.

Sometimes the tendon is ruptured across in the living body t the forcible and sudden action of the fleshy fibres. When th accident happens, the broken ends are separated widely, the upp fragment being raised by the contraction of the fleshy bellie and the lower piece being depressed by the descent of the calcis through flexion of the ankle. With the view of approx

mating the ends, the heel should be raised by forced extension of the ankle, and the knee should be bent to relax the gastrocnemius; by the adoption of the position here indicated, the upper end, which is liable to the greatest displacement, may be more readily depressed towards, and retained near the lower fragment by a bandage on the leg.

Use of the gastrocnemius and soleus. These muscles raise the os calcis, and in this way extend the ankle. Should the toes rest on the ground, so as to render the foot immoveable, the muscles can still raise the heel with the weight of the body, as in the different kinds of progression, or in standing on the toes.

If the lower attachment becomes the fixed point the soleus can render the leg-bones steady on the foot, and the gastrocnemius and plantaris will support the knee-joint, as in the straightened state of the limb in standing. During stooping to the ground the gastrocnemius and plantaris will assist in bending the knee; and in the act of rising from that posture the soleus brings back the bones of the leg over the astragalus.

Before the foot reaches the ground in walking backwards the muscles point the toes; and after the sole touches the ground they incline back the slanting limb over it.

LOWER PART OF THE POPLITEAL VESSELS.

The part of the popliteal vessels here referred to extends beyond the limits of the ham, and is laid bare by reflecting the gastrocnemius.

a. Popliteal artery.
b. Upper muscular branch.
c. Branch to inner head of the gastrocnemius.
d. Branch to outer head of the gastrocnemius and the plantaris.
e. Lower external articular artery.
f. Lower internal articular artery.
g. Branch to the soleus.
h. Popliteal vein.
j. Internal saphenous vein.
k. External saphenous vein, cut.

Popliteal artery, a. The part of this artery which is now visible extends from the knee-joint to the lower border of the popliteus muscle, I. Covered by the gastrocnemius (now reflected),

it is crossed near the ending by the small tendon of the plan-taris, and its point of splitting into the tibials is concealed by the soleus, J. Beneath it lies the popliteus, I.

Superficial and close to the artery is the popliteal vein, which gradually inclines inwards, so as to be placed altogether inside at the lower border of the popliteus.

The internal popliteal nerve, coursing along the blood-vessel changes its position to the artery in the same manner as the vein; for opposite the back of the knee-joint it lies between the vessel and the surface, but is internal to the artery at the lower border of the popliteus.

Branches. From this part of the popliteal arise the lower muscular offsets, and the lower pair of articular arteries.

The *lower muscular branches* are furnished to the muscles of the calf, viz., gastrocnemius, soleus, and plantaris.

Branches to the gastrocnemius, c and *d.* Two in number, they are named, commonly, *sural.* The artery, *c*, enters the inner fleshy belly of the muscle; and the vessel, *d*, ramifying in the outer belly, gives a small offset to the plantaris.

Branch to the soleus, g. Accompanying the nerve of the same name, it pierces the upper part of its muscle at the cutaneous aspect.

The *lower pair* of *articular arteries* are directed, one outwards the other inwards, to the front of the knee-joint.

The *outer*, *e*, runs above the head of the fibula and beneath the external lateral ligament, to the outer part of the knee where it anastomoses with the other articular arteries over the joint.

The *inner*, *f*, lying at a lower level than its fellow, passes beneath the internal lateral ligament to the inner side of the articulation, and terminates like the other. A small articular nerve takes the same course.

The *popliteal vein*, *h*, begins by the union of the anterior and posterior tibial veins at the spot where the artery ends. Internal to the artery at first, it becomes afterwards superficial, and then external, as before said. The branches joining it in this part are the same as those of the artery.

POPLITEAL NERVES.

These nerves and most of their branches have been illustrated in preceding Plates, but some of the muscular offsets of the internal nerve may be now observed more completely after the removal of the gastrocnemius.

1. Internal popliteal trunk.
2. External popliteal trunk.
3. Branch of inner head of the gastrocnemius.
4. Branch of outer head of the gastrocnemius.
5. Branch of the plantaris.
6. Branch of the soleus.
7. Lower internal articular branch.
8. Short saphenous (origin).
9. Branch of the popliteus.
10. Short saphenous (lower end).

Internal popliteal trunk, 1. The muscular branches of this nerve are furnished to the muscles of the calf and the popliteus. The nerves to the superficial muscle of the calf, viz., the gastrocnemius, have been before noticed (Plate LIII.).

The *branch to the plantaris muscle*, 5, is an offset of the nerve to the outer head of the gastrocnemius; it enters the fleshy fibres of its muscle with a small twig of an artery.

The *branch to the soleus*, 6, descends beneath the gastrocnemius, and divides into pieces which penetrate the muscle near the upper attachment to the bones of the leg, and at the superficial aspect.

The *branch to the popliteus*, 9, arises opposite the knee-joint, and passes beneath the plantaris to the lower border of its muscle: at this point it bends round the edge of the popliteus, and enters the under surface.

Lower internal articular nerve, 7, which is shown at its origin in Plate LII., appears from beneath the popliteal vessels, and passes along the upper border of the popliteus muscle with the artery of the same name; it then runs beneath the internal lateral ligament to the fore part of the knee, where it pierces the capsule of the joint.

External popliteal trunk, 2. Nearly the same view of this nerve is given in this as in the preceding Plate. Inferiorly it passes beneath the peroneus longus, and divides between that

muscle and the fibula into its terminal branches for the fore part of the leg, viz., recurrent articular, musculo-cutaneous, and anterior tibial.

DESCRIPTION OF PLATE LV.

The deep muscles, vessels, and nerves of the back of the leg are exhibited in this Plate.

The dissection for this view will be prepared by reflecting the muscles of the calf, and removing the fascia and fat which then come into sight. An aponeurosis covering the central muscle is to be divided longitudinally, and to be thrown inwards and outwards with fibres of the two lateral muscles attached to it.

DEEP MUSCLES OF THE BACK OF THE LEG.

In this group there are four muscles: three are prolonged to the foot and extend the ankle as they pass by; and the fourth crossing behind the knee, flexes this joint.

A. Popliteus.
B. Fibular origin } of the soleus.
C. Tibial origin }
D. Flexor longus pollicis.
E. Flexor longus digitorum.
F. Tibialis posticus.
G. Tendo Achillis, cut.
H. Peroneal muscles covered by fascia.

The *popliteus muscle*, A, intervenes between the contiguous end of the femur and tibia, crossing behind the knee-joint. It arises within the capsule of the joint by a tendon which is fixed to the fore part of a groove on the outer condyle of the femur; and outside the capsule, by fleshy fibres attached to the posterior ligament. The muscle is thin and fleshy, and is inserted below the head of the tibia into an impression on the posterior surface of the bone.

A special aponeurosis covers the muscle, and separates it from other parts. Towards the surface it is concealed by the gastrocnemius and plantaris; and is crossed by the popliteal vessels and the internal popliteal nerve. Beneath it is the tibio-peroneal joint with the upper end of the tibia. Along part of the upper border run the lower internal articular vessels and nerve; and contiguous to the lower edge is the soleus muscle. The tendon of origin within the capsule of the knee is surrounded by the synovial membrane in the same way as the biceps is incased in the shoulder-joint.

By the contraction of the muscle the tibia will be moved backwards towards the femur, producing flexion of the knee; and after the joint has been bent the popliteus can turn in the tibia, so as to give rise to rotation inwards.

The *flexor longus pollicis*, D, is the most external of the three muscles entering the foot. Placed over the fibula, it takes origin from the posterior surface of that bone below the soleus, except about an inch inferiorly; its fibres are further attached internally to an aponeurosis covering the tibialis posticus, and externally to the fascia separating it from the peronei muscles. Near the ankle the muscle ends in a tendon, which is continued to the foot through a separate compartment in the annular ligament, and along a groove in the astragalus; its further course through the foot to the great toe is shown in Plate LVI.

The upper part of the muscle is covered by the soleus; and the lower, which lies outside the tendo Achillis, is in contact with the deep fascia. The muscle rests on the fibula, its length of attachment to the bone varying with that of the soleus, and it conceals in part the tibialis posticus. In its fibres are contained the peroneal vessels. By the outer border it is contiguous to the peronei muscles, only fascia intervening; and by the inner edge it touches the posterior tibial nerve for its lower two thirds, but this connection has been destroyed by the displacement of the muscle.

With the foot hanging the first action of the muscle will be employed in bending the great toe, and the next in extending the ankle. When the foot is fixed this flexor assists the special ex-

tensors of the ankle in walking, and the flexor longus digitorum in standing on the toes.

If the lower end of the muscle becomes the fixed point the fibula, when placed in front of the astragalus, will be brought backwards into the position of a right angle to the foot, as is seen in rising from a stooping posture, and in walking backwards.

The *flexor longus digitorum*, E, lies on the tibia, and is the most slender of the muscles in the deep layer at the back of the leg. It arises from the posterior surface of the tibia, beginning at the attachment of the soleus, and extending to three inches from the lower end; and some fibres are connected externally to the aponeurosis covering the tibialis. Near the ankle the muscle ends in a tendon, which passes behind that of the tibialis through a separate sheath in the annular ligament, and entering the foot ends in tendons for the four outer toes (Plate LVI.).

In the leg this flexor is placed beneath the soleus for half its length, but the rest of the muscle projects inside the tendo Achillis and supports the tibial vessels. By the under surface it touches the tibia, but about three inches from the inner malleolus it is separated from that bone by the intervention of the tibialis posticus. Along the outer edge lie the tibial vessels for about the upper half of its length, but below that point it projects outwards beyond the vessels.

The foot being moveable the long flexor will bend the four outer toes, and extend afterwards the ankle. If the foot rests on the ground, so that the toes are rendered immoveable, the muscle will be united in its action with the preceding flexor to raise the weight of the body, as in standing on the toes, or in walking.

Supposing the tibia placed in front of the astragalus, as in stooping, the muscle acting from below will assist in bringing that bone to a right angle with the foot.

The *tibialis posticus*, F, is the central muscle of the deep layer, and covers the membrane between the bones. It has a wide origin from the interosseous membrane, the tibia, and the fibula;—viz., from all the membrane except an inch below; from a special surface on each bone, which is contiguous to the membrane, and reaches down as far as two inches from the malleolus; and some

fleshy fibres are also attached to the aponeurosis covering the surface. Inferiorly the muscle passes between the tibia and the flexor longus digitorum; and its tendon is transmitted to the foot through the inner space of the annular ligament, lying next the tibia in the groove in the inner malleolus. Its insertion into the scaphoid and other bones of the foot appears in Plate LVII. Fig. 2.

Situate between the flexors of the digits, the tibialis is covered by the thin aponeurosis which is fixed into the leg-bones, and superficial to all is the soleus: on it lie the tibial vessels and nerve for the upper half. Beneath it is the interosseous membrane. Superiorly there is an interval between its attachments to the bones, through which the anterior tibial vessels pass; and inferiorly the muscle is directed inwards beneath the flexor longus digitorum.

Should the foot be free to be moved the tibialis posticus will draw it backwards so as to extend the ankle, and will direct inwards the great toe at the same time. If the foot rests on the ground, the muscle uniting in its action with the tibialis anticus will raise the inner edge, as in standing on the outer border of the foot.

When the bones of the leg slant forwards, as in stooping, the muscle taking its fixed point below will combine with the deep flexors of the digits in bringing back the tibia over the astragalus as the leg is straightened.

DEEP VESSELS OF THE BACK OF THE LEG.

At the back of the leg as on the front of the forearm the main artery of the limb bifurcates just beyond the joint, and from the chief of the two pieces into which it splits is given a third artery, so that in each member there exists one main blood-vessel where there is a single bone, and three where there are two bones.

Arteries.	Veins.
a. Popliteal trunk.	*k.* Popliteal trunk.
b. Lower external articular.	*l.* Peroneal venæ comites.
c. Lower internal articular.	*n.* Venæ comites, posterior tibial.
d. Anterior tibial trunk.	*o.* Communicating from deep to superficial veins.
e. Peroneal trunk.	*p.* Internal saphenous.
f. Continuation of peroneal.	
g. Posterior tibial trunk.	

The *anterior tibial artery*, *d*, is one of the two trunks into which the popliteal splits at the lower border of the popliteus muscle; it passes above the interosseus membrane to the front of the leg, and its anatomy is illustrated in Plate LVIII.

The *posterior tibial artery*, *g*, the other trunk obtained from the division of the popliteal, extends to the sole of the foot, and ends in the plantar arteries. It is limited by the lower border of the popliteus in one direction, and by the lower edge of the internal annular ligament in the other. On the surface of the limb its position would be indicated by a line from the centre of the knee-joint to a point midway between the heel and the ankle. The upper half of the vessel lies deeply, and the lower is comparatively superficial.

Upper half. Placed beneath the soleus, as is seen in the preceding Plate, it rests on the tibialis posticus, F. Close to it internally is the flexor longus digitorum, and lying outside it near the termination is the flexor longus pollicis.

Companion veins course along the sides of the artery, and join across it at short distances.

The large posterior tibial nerve lies close to the artery: at the upper end it is internal, but it becomes external to that vessel below the origin of the peroneal artery; and it keeps afterwards the same position.

Lower half. Below the middle of the leg the soleus ends in its tendon, and the artery gradually inclining inwards comes to lie between the tendon and the edge of the tibia. Here it is covered by the deep fascia and teguments, and lies on the flexor longus digitorum and the end of the tibia: on its outer side is placed the flexor longus pollicis as in the upper part.

The venæ comites and the posterior tibial nerve have the same position to this as to the upper half.

Between the heel and the ankle the artery passes under the internal annular ligament and over the ankle joint; and it divides at the lower border of that band into the two plantar arteries. Internal to it in this spot lies the tendon of the long flexor of the toes, and external and nearer to it, the tendon of the long flexor

of the great toe. The companion veins and nerve have the same position as above.

Size and position of the branches. Numerous small branches, chiefly muscular, arise at intervals along the artery; but about one inch and a half from the beginning springs the large peroneal trunk, and near the ankle-joint a branch of intermediate size (communicating) leaves it.

Ligature of the artery. In the living body the artery is not likely to need tying except in the case of a wound of the leg or foot, and reference will be afterwards made to those states; but the placing a ligature on the vessel in the dead body may be practised in both the upper or deep, and the lower or superficial part.

In the upper half. Where the posterior tibial is covered by the soleus it may be reached in the following way:—A longitudinal incision about four inches long is to be carried through the integuments and deep fascia at the distance of an inch behind the edge of the tibia:* this cut should lie behind the internal saphenous vein, and near the edge of the gastrocnemius (Plate LIII.). Should this last muscle come into sight it is to be turned aside, and the soleus which then appears is to be cut through for the whole length of the superficial incision; whilst this step is being executed the ankle is to be extended with the view of relaxing the muscle, and as the fleshy fibres are divided an aponeurosis on the under surface shows itself. On carefully cutting through this aponeurotic part, and a thin piece of the deep fascia under it, the blood vessels will be arrived at immediately beneath, though external to the line of the incision.

To find the artery, look for the posterior tibial nerve, which lies on the outer side of, and may be taken as the deep guide to the vessel.

Only a very thin sheath encloses the vessels; and in opening and detaching it care should be taken of the venæ comites.

* If the cut is made near the edge of the tibia, with the view of separating this muscle from the bone, as is sometimes recommended, the student is apt to detach also the deep flexor of the toes, and to experience some difficulty in finding the interval between the muscles.

In passing the ligature let the aneurism needle be moved from right to left, and without including the veins.

Occasionally no artery may be met with, for it may be wanting in this part of the leg.

In the lower half. Where the posterior tibial is uncovered by muscle the surface line before given will serve as the superficial guide to its position. A cut about two inches and a half long is to divide the teguments in that line: some branches of the internal saphenous vein and nerve will probably be cut through in this stage, but the knife should be used far enough back to be clear of the trunk of the vein. Nextly the deep fascia of the limb is to be incised on a director or without, according to the skill of the operator.

Beneath the fascia the posterior tibial nerve may be recognised, and it will serve as the guide to the artery in the wound: to the inner side of the nerve lie the blood-vessels.

When opening the sheath, and passing the thread around the vessel, the same precautions are to be taken as in ligature of the artery higher up.

Wounds of the artery are more likely to happen to the lower part of the leg where the vessel is near the surface than where it is covered by the soleus muscle. If the injury has its seat in the lower half of the leg the wound may be enlarged, and two ligatures may be applied to the blood-vessel so as to arrest the flow of blood from each end. But if the artery is opened through the soleus the depth will increase greatly the difficulty of finding the bleeding vessel in the bottom of the wound. In this case some surgeons have recommended that the wound should be enlarged, and that the vessel should be tied, as before said; but others would prefer to try the effect of pressure applied to the wound and the main blood-vessel of the limb before undertaking so difficult an operation.

Branches of the posterior tibial. With the exception of the large peroneal artery the other branches are small in size.

Muscular branches arise from both sides of the trunk all the way along: two or three are supplied to the fibular and tibial attachments of the soleus; and the larger of these pierces the

tibial part, and ramifies on the head of the tibia and the inner side of the knee-joint. The remaining offsets enter the tibialis posticus and the flexors of the digits.

Cutaneous offsets. Some small branches pierce the fascia in the lower half of the leg, and end in the teguments (Plate LIII.): one or two of this set arising near the ankle, run with the cutaneous plantar nerve, 7, to the sole of the foot.

Nutritions of the shaft of the tibia. It is derived from one of the upper muscular branches, and pierces the fibres of the tibialis posticus to enter the canal on the posterior surface of the bone.

A *communicating branch* is directed transversely outwards across the lower end of the tibia to join with a like offset from the peroneal artery ; it is concealed by the flexor longus pollicis.

The *articular branches* arise from the artery opposite the ankle-joint, and are distributed to that articulation.

The *venæ comites, n,* of the posterior tibial artery lie one on each side of that vessel, over which they are united by cross pieces: they have the same extent as the artery, viz., from the lower border of the popliteus to the foot. Above, they unite with the companion veins of the anterior tibial artery to form the popliteal vein. At the lower part of the leg they are thick and strong.

The *peroneal artery, e,* is the largest branch of the posterior tibial, and arises one inch and a half from the beginning of that trunk. To reach the fibula it passes between the soleus and the tibialis posticus ; and it is then continued along that bone, contained in the fibres of the flexor pollicis. Much diminished in size at the lower part of the interosseus membrane, the vessel, *f,* is continued behind the external malleolus to the outer side of the heel ; here it ends in branches, of which some supply the foot, and others anastomose with offsets of the posterior tibial, and external plantar and tarsal arteries.

Two companion veins run with the artery, and the nerve to the flexor pollicis lies on it oftentimes.

Its *branches* are muscular and communicating, but they are concealed by the flexor pollicis.

Muscular branches enter the muscles with which it is in contact, viz., soleus, tibialis, and flexor pollicis; and some wind round

the outside of the fibula, lying in grooves in the bone, to reach the peronei.

The *nutritive artery of the bone* is furnished by one of the muscular branches, and enters the aperture in the shaft of the fibula, after piercing the tibialis: it is smaller than the artery to the tibia.

Communicating branches. Two in number, anterior and posterior, they serve the purpose of anastomosing with the anterior and posterior tibial arteries.

The anterior passes to the front of the leg through an aperture in the lower part of the interosseous membrane, and is commonly named *anterior peroneal.* It is continued to the dorsum of the foot on the outer side, and some of its offsets anastomose with the external malleolar and tarsal arteries. When the anterior tibial trunk is unusually small, or is wanting on the foot, this communicating branch is proportionally augmented, taking the place of the deficient artery in the one case, and assisting the smaller trunk in supplying the foot in the other condition.

The posterior communicating lies beneath the flexor pollicis, opposite the lower end of the tibia, and unites with a similar branch of the posterior tibial (p. 431). Sometimes there is a second communicating artery lower down. If the trunk of the posterior tibial is absent in the lower part of the leg this branch of the peroneal, much increased in size, takes the place of that blood-vessel, and enters the sole of the foot to supply the plantar arteries.

The *companion veins, l,* (venæ comites) of the peroneal artery lie on the sides of that vessel, and communicate across it: they receive branches corresponding with the offsets of the artery, and end above in the posterior tibial veins.

The *posterior tibial nerve,* 9, is a continuation of the internal popliteal trunk, and extends from the lower border of the popliteus muscle to the space between the inner malleolus and the os calcis, where it divides near or beneath the annular ligament into the two plantar nerves. Its connections with muscles are the same as those of the blood-vessel. In close contact with the artery throughout, it changes its place with respect to the vessel: thus

for an inch and a half it lies inside, but thence to its termination outside the artery.

Its *offsets* are chiefly supplied to the contiguous muscles, but it gives a cutaneous nerve to the sole of the foot.

The *muscular branches*, 4, 5, 6, enter the tibialis posticus, flexor digitorum, and flexor pollicis: they arise at intervals along the nerve, or sometimes by a common branch from the internal popliteal trunk.

A *cutaneous plantar nerve*, 7, begins above the os calcis, and dividing into two or more branches is continued beneath the fascia nearly to the sole of the foot; its offsets, accompanied by small arteries, pierce separately the internal annular ligament, and end in the teguments of the under part of the heel (Plate LVI.).

The *internal saphenous vein*, *p*, begins in a cutaneous venous arch on the dorsum of the foot (Plate LVIII.); it then ascends, crossing the tibia above the inner ankle, and takes afterwards a position behind the posterior edge of that bone as far as the knee, where it has been shown (Plate XLIX.) passing that articulation to reach the thigh. A nerve of the same name accompanies it.

Many superficial branches enter it in this course. In the leg it communicates with the deep veins—anterior and posterior tibial, and near the knee it joins an internal articular vein. In the Figure a branch, *o*, is represented uniting it with the posterior tibial veins.

The *internal saphenous nerve*, 8, accompanies the vein of the same name to the inner side of the foot, where it ends about the middle of the tarsus, as may be seen in Plate LVIII. In the leg it furnishes many collateral cutaneous offsets both forwards over the tibia and front of the limb, and backwards behind but near that bone.

DESCRIPTION OF PLATE LVI.

VIEWS of the first two dissections of the sole of the foot are represented in the Figures of this Plate.

FIGURE I.

In this Illustration the dissection of the superficial vessels and nerves with the first layer of muscles is displayed.

After the removal of the skin, the cutaneous vessels and nerves are to be sought; and when the fat and the subjacent plantar fascia have been taken away the first layer of muscles comes into sight. The digital nerves and vessels, appearing between the muscles about the middle of the foot in length, are next to be traced onwards to the toes.

FIRST LAYER OF MUSCLES.

Three muscles enter into this layer:—the central one is the short flexor of the toes; the muscle in a line with the great toe is the abductor pollicis; and that lying along the outer border of the foot is the abductor minimi digiti.

A. Abductor pollicis.
B. Flexor brevis digitorum.
C. Abductor minimi digiti.
E. Flexor tendon of the great toe.
H. Lumbricales.
K. Transverse ligament of the toes.
N. Flexor brevis pollicis.
O. Flexor minimi digiti.
P. Interossei of the outer space.

The *flexor brevis digitorum*, B, acts on the four outer toes; and it is called flexor perforatus from its tendons being pierced by those of the long flexor. The muscle has a narrow origin posteriorly from the inner side of the large tubercle at the back of the os calcis, and from the investing plantar fascia. About the middle of the foot it is divided into four fleshy parts, the outer being very small, and from each part proceeds a tendon to the

root of the toe, where it enters a fibrous sheath with an offset of the long flexor (Fig. ii.). Lastly, in the sheath the tendon of the short flexor, I, (Fig. ii.) is pierced opposite the metatarsal phalanx, as in the finger, for the passage of the tendon of the other muscle, J; and it is then inserted by two parts into the sides of the middle phalanx.

The muscle is incased in a sheath of the plantar fascia, of which a piece has been shown on the surface. Along the outer side lies the abductor of the little toe, and along the inner, the abductor of the great toe. The parts covered by it are delineated in Fig. ii., viz. the tendons of the long flexors with the accessory muscles, and the plantar vessels and nerves. Its tendons decrease in size from the inner to the outer side; and that to the little toe, may be very small and not pierced, or it may be even absent: near the toes they are crossed by the digital nerves.

When this flexor contracts it will move the middle phalanges of the four outer toes towards the sole, bending the first phalangeal joint, as in the fingers.

The *abductor pollicis*, A, the most internal muscle of the first layer, takes origin behind by a wide attachment to the inner part of the larger tubercle of the os calcis; to the lower border of the internal annular ligament; to the inner side of the tarsus (its ligamentous structures) as far forwards as the scaphoid bone; and to the plantar fascia, though not so largely as the other two muscles. Anteriorly it ends in a tendon, and is inserted into the inner side of the base of the metatarsal phalanx of the great toe, in union with the inner head of the short flexor.

Contained in a sheath of the plantar fascia, it is separated behind from the short flexor of the toes by an intermuscular partition, and in front by the internal plantar vessels and nerve which issue between the two. In Fig. ii. the parts covered by it may be perceived, viz. the long flexor tendons, the accessory muscle, and the internal plantar vessels and nerve.

As the name expresses the muscle will abduct slightly the great toe from the others; but as it lies almost parallel with the digit moved, it will be employed mainly in assisting the short flexor to bend the metatarso-phalangeal joint.

The *abductor minimi digiti*, C, is wide behind, like the abductor pollicis, and arises more largely from the os calcis, viz. from the fore part of the inner or larger tubercle, and from the outer tubercle; and many fibres are attached to the plantar fascia both superficially and on the outer side. In front the muscle is inserted by tendon into the outer side of the metatarsal phalanx of the little toe.

Like the two preceding muscles it is invested by the fascia. Internal to it behind is the short flexor of the toes, with an intermuscular septum of fascia intervening; and about the middle of the foot the offsets of the plantar vessels and nerves separate them. When the muscle is everted, as in Fig. ii., it will be seen to rest on the flexor accessorius, F, the peroneus longus, and the short flexor of the little toe, O.

The muscle can abduct the little toe from its fellows, and bend the first joint of that toe after the same manner as the abductor pollicis.

Superficial transverse ligament of the toes, K. In the form of a flattened band it reaches from the outer to the inner toe, and consists of transverse fibres which are united to the sheaths of the flexor tendons. Under it pass the digital vessels and nerves. It serves the purpose of uniting together the roots of the digits, as in the hand. A deeper transverse ligament connects the heads of the metatarsal bones.

SUPERFICIAL ARTERIES OF THE SOLE.

Near the roots of the toes appear the digital arteries, which spring from the plantar trunks; and over the muscles ramify cutaneous vessels of the posterior tibial and plantar arteries.

a. Cutaneous branch of the sole.
b. Internal plantar trunk.
c. External plantar trunk.
d. Digital branch of outside of little toe.
e. Digital branch of inside of great toe.
f. Digital branch of first and second toes.
g. Digital branch of second and third toes.
h. Digital branch of third and fourth toes.
i. Digital branch of fourth and fifth toes.

Cutaneous arteries. The teguments of the posterior part of the sole receive branches from the posterior tibial trunk, and those of the rest of the foot are supplied by the plantar arteries.

The *cutaneous plantar* of the posterior tibial, *a*, is shown at its origin in Plate LV : when it is small there may be two instead of one. Piercing the internal annular ligament as one or two branches, which accompany the cutaneous nerve, it ramifies in the teguments of the under and fore part of the heel. Its venæ comites join the posterior tibial veins.

Cutaneous branches of the plantar arteries issue by the sides of the flexor brevis digitorum—between it and the abductor pollicis internally, and between it and the abductor minimi digiti externally; and towards the toes the cutaneous offsets are furnished by the digital arteries :—These several branches supply the integuments anterior to the distribution of the artery, *a*.

The *plantar arteries*, the chief vessels of the sole of the foot, are two in number, inner and outer: they are derived from the splitting of the posterior tibial at the lower border of the internal annular ligament; and their connections with muscles at the hinder part of the foot can be observed in Fig. ii.

The *internal plantar*, *b*, is directed beneath the abductor pollicis (the sole of the foot being up) to the interval between this muscle and the flexor brevis digitorum, where it becomes superficial opposite the back of the first interosseous space. It is then directed down and out over the flexor tendons,* in company with venæ comites and the internal plantar nerve, and ends at the fore part of the third interosseous space by joining the third digital artery, *h*.

Whilst the artery retains its deep position it furnishes cutaneous branches of the sole, muscular branches to the abductor pollicis and flexor perforatus, and deep offsets to the bones and ligaments of the inner part of the tarsus. After the vessel

* The condition of the artery which is represented in this Plate differs much from that which is ordinarily described. This arrangement is very common ; but as the arteries of the foot, like those of the hand, are subject to great variations in their distribution, a large number of observations would be required to determine whether this is the most frequent state.

reaches the surface it supplies the following superficial digital and deep or muscular branches.

The *superficial digital branches* are three slender arteries which run forwards, and are thus arranged :—

The most internal belongs to the inner side of the foot and great toe, and gives offsets to the abductor and flexor brevis pollicis ; it communicates with the artery, *f*, of the first interosseous space by a cross branch under the long flexor tendon.

The second, lying over the first interosseous space, joins the digital artery, *g*, at the root of the toes.

The third, enters the digital artery, *h*, like the others.

The *muscular branches*, which are shown in Fig. ii. penetrate the fibres of the flexor brevis pollicis, and the inner two lumbricales muscles.

The *external plantar artery c*, (Fig. ii.) has an arched course to the back of the fourth interosseous space, and there sinks under the third layer of muscles to form the plantar arch (Plate LVII.). Covered at first by the abductor pollicis, it is placed next between the flexor digitorum and the accessorius, F, and finally it lies in the interval between the flexor of the toes and the abductor of the little toe. Venæ comites are continued on the sides of the artery; and the external plantar nerve has the same course and connections.

Collateral branches are furnished from this part of the artery to the contiguous muscles,—abductor minimi, flexor digitorum, and flexor accessorius ; and to the bones and ligaments of the outer side of the foot : these last communicate with the arteries on the dorsum.

From the deep part of the plantar artery (plantar arch) the digital arteries on the sides of the toes are derived ; but a more complete view of these will be obtained in the following Plate.

NERVES OF THE SOLE.

The nerves, like the arteries, consist of cutaneous and deep branches: the former come from the posterior tibial and plantar

nerves; and the latter are the terminal pieces of the posterior tibial nerve.

1. Cutaneous plantar nerve.
2. Internal plantar trunk.
3. External plantar trunk.
4. Digital of inner side of great toe.
5. Digital of first and second toes.
6. Digital of second and third toes.
7. Digital of third and fourth toes.
8. Communicating of plantars.
9. Digital of fourth and fifth toes.
10. Digital of outside of little toe.

The *cutaneous plantar* nerve, 1, whose origin appears in the preceding Plate, ramifies in the integuments of the heel, viz. in that part on which the foot rests in standing.

Along the sides of the flexor brevis digitorum other nerves, derived from the plantar trunks, pierce the fascia, and become cutaneous. Near the roots of the toes, and along the borders of the foot, branches are also furnished to the teguments from the digital nerves.

The *plantar nerves*, two in number like the arteries, are obtained from the bifurcation of the posterior tibial trunk beneath the annular ligament (p. 432). In Fig. ii. the first or deep part of each is visible; and their termination on the toes may be observed in Fig. i.

The *internal* nerve, supplies but few muscles, and ends anteriorly in digital branches for the three inner toes and half the fourth. Beginning on the inner side of the heel, it is directed forwards under cover of the abductor pollicis to the middle of the sole (in length). At this spot the nerve comes forwards between the abductor and the flexor digitorum, and is inclined downwards and outwards towards the fore part of the third interosseous space where it ends in the fourth digital nerve, 7. In the superficial part of its course it lies over the flexor tendons, being covered by the plantar fascia.

While the nerve is beneath muscle it gives branches to the abductor pollicis and flexor digitorum; and after it becomes superficial it sends forwards the digital branches.

The *digital branches*, four in number, are named first, second, and so forth, from the inner to the outer border of the foot. At first they are covered by the plantar fascia, but near the root of

the toes they issue between the processes of that fascia, though the first or most internal enters the tegaments farther back than the rest. Each, except the first, bifurcates to supply the contiguous sides of two toes. On the digits they are continued along the lateral aspect, as in the hand; and distributing in their course cutaneous and articular offsets, end on the last phalanx in a tuft of fine nerves from which the ball of the digit is principally supplied.

The first digital nerve, 4, courses to the inner side of the great toe, and sends many cutaneous branches to the inside of the foot anterior to the tarsus: an offset from it enters the flexor brevis pollicis.

The second digital, 5, supplies the most internal lumbricalis muscle, and ends in the sides of the second and third toes.

The third digital, 6, belongs to the neighbouring sides of the third and fourth toes, and gives a branch to the second lumbricalis muscle.

The fourth digital, 7, is distributed, like the others, to the collateral sides of the third and fourth toes, and is joined by a communicating branch, 8, from the external plantar.

The internal plantar nerve in the foot resembles the median in the hand in its supply to three digits and a half; in the arrangement of its digital branches; and in having a communication with the nerve furnished to the remaining digits. Like the median it gives branches also to the first two lumbricales, and the abductor and flexor brevis pollicis.

But as the muscles of the first digits are not alike in the hand and foot the distribution of the two nerves is not identical throughout. For instance in the foot there is not any branch corresponding with that given by the median to the opponens pollicis; and none in the hand answering to the nerve of the flexor perforatus in the foot. Lastly the whole of the flexor brevis pollicis is supplied by the internal plantar nerve in the foot, but only the outer head of the muscle in the hand receives a branch from the median.

The *external plantar nerve*, 3, is chiefly expended in muscles, and emits digital branches only to one toe and a half, like the ulnar nerve in the hand.

It begins inside the heel with the internal plantar (Fig. ii.), and is directed outwards across the foot towards the back of the fourth interosseous space, where it sends off digital branches, and then sinks into the sole of the foot with the external plantar artery to end in deep muscles: its termination may be ascertained in Plate LVII. In this course the nerve lies at first under the abductor pollicis, nextly between the flexor brevis digitorum and flexor accessorius, and lastly in the intermuscular space between the flexor of the digits and the abductor minimi digiti. It is accompanied by the internal plantar nerve and venæ comites, but the nerve is not always situate on the same side.

From this part of the nerve branches are sent to the abductor of the little toe, and the flexor accessorius: these are visible in Fig. ii.

The *digital branches*, two in number, run forwards beneath the plantar fascia, and become subcutaneous near the toes, between the digital processes of the fascia: but the most external nerve pierces the fascia farther back than the other. One of the two (internal) splits at the front of the fourth interosseous space, like the branches of the other plantar, to end in the adjacent borders of the fourth and fifth toes; but the other remains undivided on the outer side of the little toe. As these branches are continued along the toes they have the same arrangement as the digital branches of the internal plantar nerve.

The branch for the outer side of the little toe, 10, gives many cutaneous offsets to the anterior half of the outer border of the foot: it may supply also the contiguous muscles, viz., the flexor minimi digiti, O, and the interossei of the fourth space.

The branch, 9, which ramifies in the collateral sides of the fifth and fourth toes, communicates by means of the branch, 8, with the internal plantar, but does not supply any muscle.

FIGURE II.

The second layer of muscles of the foot, and the trunks of the plantar vessels and nerves may be studied with this Figure.

To obtain this view the first layer of muscles is to be cut

through near the heel, and is to be removed in part, as is here shown. Then the dissection will be completed after the removal of the fat and fascia.

SECOND LAYER OF MUSCLES.

In this group are included the flexors of the digits which take origin at the back of the leg, viz. flexor longus pollicis, and flexor longus digitorum with its accessory muscles. The same letters in the two Figures mark the same parts.

D. Flexor longus digitorum.
E. Flexor longus pollicis.
F. Flexor accessorius.
G. Inner head of accessorius.
H. Lumbricales.
I. Tendon of flexor brevis digitorum.
J. Tendon of flexor longus digitorum.
L. Sheath of flexor tendons.
N. Flexor brevis pollicis.
O. Flexor minimi digiti.
P. Interossei.
Q. Tendon of peroneus longus.

Tendon of flexor longus pollicis, E. Issuing at the back of the foot from a groove in the astragalus and os calcis, where it is enveloped by a synovial membrane, it is directed inwards to the root of the great toe; it then enters the digital sheath, where it is incased in a second synovial sac, and is inserted into the base of the ungual phalanx.

In the foot it rests on the flexor brevis pollicis, N, and lies under the tendon of the flexor longus digitorum, D: to this last tendon it is connected by a slip, which is prolonged most commonly into those pieces of the common flexor of the digits belonging to the second and third toes, and in greatest proportion to the inner one (Turner).*

Tendon of flexor longus digitorum, D. This tendon appears on the inner part of the foot; it is then inclined towards the middle of the sole, and divides into four pieces for the four outer toes. Each of these pieces, J, enters the digital sheath with a tendon, I, of the short flexor, and having pierced that tendon is inserted into the base of the last phalanx.

* On Variability in Human Structure, by William Turner, M.B.; Trans. of Royal Soc. of Edinb., vol. xxiv.

As the tendon escapes from the internal annular ligament it lies internal to the flexor pollicis, and is surrounded by a synovial membrane as far as the place of junction with it of the accessorius muscle F; and as it crosses over the tendon of the flexor of the great toe a communication is established between the two, as before said. Finally from the pieces into which the tendon splits a group of four accessory muscles—the lumbricales—takes origin. The parts covered by the tendon are set forth in Fig. i. of the following Plate.

Sheaths of the flexor tendons. Along the four outer toes the pieces of the short and long flexor are lodged in a partly osseous and partly membranous canal, as in the fingers. Towards the plantar surface the sheath is formed by fibrous bands, L, which are strongest opposite the centre of the two nearest phalanges, and thinnest opposite the joints; whilst at the opposite aspect it is constructed by the bones which are hollowed out to be adapted to the tendons. A synovial membrane lubricates the sheath, as in the fingers, and reaches posteriorly along the tendons nearly to the attachment of the lumbricales. In the sheath accessory bands are connected with the tendons; and these are similar to, but not so well marked as those in the hand (p. 87). In the sheath of the great toe only one tendon is contained.

Action of the flexors on the toes. In both members the bending of the digits takes place in the same order. Firstly the hinder phalangeal joint is flexed by the short flexor carrying down the middle phalanx. Nextly the anterior joint is bent by the long flexor drawing the last phalanx towards the sole. And lastly the metatarso-phalangeal joint is flexed by the indirect action of the two tendons bound to the first phalanx by the sheath of the digit, and by the direct contraction of the lumbricalis and interossei muscles.

The *musculus accessorius*, F, is a squarish fleshy mass, which has received its name from assisting the long flexor to bend the digits. It is bifurcated behind, and arises externally by tendon from the outer surface of the os calcis and the long plantar ligament, and internally by a thick fleshy part, G, from the inner concave surface of that bone. About the middle of the sole it becomes ten-

dinous, and ends most commonly by joining the flexor perforans and the slip of the flexor pollicis, to form tendons for the second, third, and fourth, digits.*

On the muscle rest the external plantar nerve and vessels, and the flexor perforatus; and under it lie the os calcis and the long plantar ligament. Between the heads of origin of the muscle a piece of the plantar ligament appears.

Supposing the long flexor to act alone the four outer toes would be bent somewhat under each other; but when the accessorius contracts it opposes that oblique inward movement of the digits, and with the help of the flexor perforatus bends the toes directly back.

Lumbricales, H. Four in number, they serve as accessory flexor muscles to the four outer toes; and are named first, second, &c., from the inner to the outer side of the foot. They take origin behind from the pieces into which the flexor perforans splits, the most internal being fixed commonly to only one, and each of the three others to two tendinous slips. Near the meta-tarso-phalangeal articulation each ends in a tendon, which passes at the tibial side of the toe to join the extensor tendon on the dorsum of the first phalanx: as they bend down by the sides of the joints they are closely attached to the metatarsal phalanx, or are inserted into it by a thin tendinous slip.

The muscles decrease in size from the first to the fourth. At the root of the toes they become cutaneous between the processes of the plantar fascia with the digital nerves and arteries, and they appear there even before the removal of the superficial flexor muscle (Fig. i.).

Contracting with the long flexor these muscles bring down to the sole the metatarsal phalanges, thus serving as flexors of the metatarso phalangeal joints of the four outer toes.

Plantar arteries. In the second Figure the course of these vessels between the first two strata of muscles may be observed. Of the two the external is the largest, and furnishes most digital

* Professor Turner in the Paper (Trans. of the Roy. Soc. of Edinb.) before referred to.

branches to the toes; but a more complete view of these arteries will be contained in the next Plate. In this Figure the small muscular branches of the internal plantar artery to the inner two lumbricales, and to part of the flexor brevis pollicis are displayed.

Plantar nerves. Two in number like the arteries, there is not the same disparity in size between them, for though one supplies most digits the other gives offsets to most muscles. They are placed with the bloodvessels between the first two muscular strata. The distribution of the internal nerve to three digits and a half and a few muscles has been given at p. 439; and the arrangement of the external nerve, which is furnished to one digit and a half and many muscles, will be afterwards considered.

DESCRIPTION OF PLATE LVII.

In this Plate the last two stages of the dissection of the foot are delineated.

Figure I.

Part of the external plantar vessels and nerve, with their branches, and the short muscles of the great and the little toe are represented in this Figure.

After making the preparation of the parts illustrated in Fig. II. of the foregoing Plate, the dissection of the third stage will be completed by dividing the accessorius muscle and the tendons of the flexors of the digits about two inches in front of the heel; and by removing the areolar tissue from the muscles, vessels, and nerves, after the flexor perforans with its lumbricales has been thrown forwards to the toes. Whilst the flexor tendon is being raised the small nerves and arteries to the outer two lumbricales muscles are to be sought with care.

MUSCLES OF THE THIRD LAYER.

This stratum consists chiefly of the short muscles of the great and little toes, which reach scarcely farther back than the metatarsal bones: they are the short flexor and adductor of the great toe, the short flexor of the little toe, and a fourth muscle (transversalis pedis) which crosses the heads of the metatarsal bones.

N. Flexor brevis pollicis.
O. Flexor brevis minimi digiti.
Q. Peroneus longus.
R. Adductor pollicis.
S. Transversalis pedis.
T. Part of the tendon of the tibialis posticus.
U. Long plantar ligament.

The *flexor brevis pollicis*, N, the most internal muscle of the set, is pointed and tendinous behind, but is split anteriorly into two pieces or heads. Its tendon is attached posteriorly to the cuboid bone, and blends with the prolongation, T, from the tendon of the tibialis posticus to the outer cuneiform bone. Towards the front of the metatarsal bone it is divided into two heads, and these are inserted into the base of the first phalanx;—the inner joining the abductor pollicis, A, and the outer blending with the adductor, R.

Superficial to the muscle is the tendon of the long flexor; and underneath it lie the deep vessels of the foot. In each head of insertion a sesamoid bone is incased.

The muscle draws towards the sole the metatarsal phalanx, to which the long flexor tendon is not attached, and so bends the metatarso-phalangeal joint of the great toe.

The *adductor pollicis*, R, arises behind from the sheath of the peroneus longus tendon, Q, and from the bases of the second, third, and fourth, metatarsal bones. In front it joins the outer head of the flexor brevis pollicis, and is inserted with this part into the outer side of the first phalanx of the great toe.

It is concealed by the flexor perforans and the lumbricales; it covers some of the interossei, and the external plantar vessels and nerve. United with it at the insertion is the transversalis pedis.

Acting with the transversalis pedis the muscle will adduct the great toe to the others; and in concert with the short flexor and abductor it will bend the metatarso-phalangeal joint.

Transversalis pedis, S. This is a thin fleshy slip, which lies across the heads of the metatarsal bones. It arises by bundles of fibres from the capsule of the metatarso-phalangeal articulations of the fourth, third, and second, toes (sometimes the fifth); and from the fascia covering the interossei muscles. Internally it is inserted with the adductor into the nearest phalanx of the great toe.

By its cutaneous surface it is in contact with the flexor perforans, the lumbricales, and the digital nerves; and by the deep, it touches the interossei and the digital vessels. The muscle is described by Theile as a short head of the adductor pollicis.

From its position and attachment to the four inner toes it will approximate them to one another.

The *flexor brevis minimi digiti*, O, lies on the metatarsal bone of the little toe, and resembles the interossei. Posteriorly it arises from the base of the fifth metatarsal bone, and from the sheath of the peroneus longus tendon; and it is inserted anteriorly into the base of the first phalanx after blending with the capsule of the metatarso-phalangeal articulation, and into the fore part of the metatarsal bone (Theile).

As the name signifies the muscle may be used as a flexor of the metatarso-phalangeal joint; but it may draw down slightly the outer border of the foot in consequence of its attachment to the metatarsal bone.

EXTERNAL PLANTAR NERVE.

As far as the root of the little toe the external plantar with its digital offsets was shown in the preceding Plate, and the remainder or the deep part of the nerve is represented in this view.

2. Internal plantar nerve, cut.
3. External plantar nerve.
4. Superficial or digital part of external plantar.
5. Deep part of external plantar.
6. Branch to transversalis pedis.

†† Branches to outer two lumbricales.

The *deep part* of the ***external plantar nerve***, 5, is directed downwards beneath the flexor perforans and the lubricales, and ends in branches to the adductor pollicis, R. In this course it accompanies the external plantar artery, and distributes branches to the neighbouring muscles of the third and fourth strata as below :—

To the under surface of the adductor pollicis two or three branches (the terminal pieces of the nerve) are distributed: one is shown piercing the outer border.

A slender branch, 6, enters the transversalis pedis : in this figure it was divided into two.

For each of the outer two lumbricales there is a small branch of nerve, †, which enters the under surface with an arterial offset. Commonly these branches are destroyed as the flexor muscle is raised.

All the interossei receive branches from the external plantar, but these are more fully illustrated in Fig. ii.

In its distribution in the foot this nerve resembles closely the ulnar nerve in the hand. Like its representative in the other member it gives many muscular and but few digital branches. Thus it supplies one digit and a half, and the teguments of that border of the foot which is in a line with the smallest digit. Like the ulnar too it furnishes branches to all the muscles of the small digit, and to the adductor of the large digit ; and in the same way as that nerve it sends offsets to the outer two lumbricales and to all the interossei.

Differences in the distribution of the two nerves are due to a want of similarity in the muscles of the first and fifth digits, and to the existence of some special muscles in each member. For instance the opponens or adductor minimi digiti is present in the hand but not in the foot, and will have a separate branch from the ulnar. The short flexor of the thumb is a less simple muscle than that of the great toe, and is supplied in part (inner head) by the ulnar; whilst the external plantar does not reach the homologous muscle in the foot.

One special muscle in the hand (palmaris brevis) is supplied by the ulnar; and two special muscles in the foot (accessorius and

transversalis pedis) obtain their nerves from the external plantar.

The *external plantar artery*, *c*, crosses the sole of the foot with its nerve, to form the plantar arch. Digital and muscular branches come off from the arch : the former of these and the trunk will be delineated in Fig. ii.; and the latter, which enter the neighbouring muscles, are visible in this stage.

Each of the two external lumbricales receives an arterial twig, and there is sometimes another branch for the second lumbricalis muscle, as in this dissection.

The transversalis pedis is supplied on the under surface by one or more of the subjacent digital arteries.

For the interossei of the three outer spaces offsets are derived from the digital arteries and the arch (Fig. ii.).

Branches to the adductor pollicis penetrate the fibres by the under surface, like the nerves.

From the most external digital artery branches are sent off to the flexor brevis minimi digiti.

Veins. The companion veins of the plantar arch and its branches were purposely removed in the dissection to render the view less complicated.

FIGURE II.

The fourth stage of the dissection of the foot is depicted in this Figure.

By cutting across and removing the adductor and part of the flexor brevis pollicis the plantar arch will be laid bare ; and by removing the transversalis pedis and the transverse metatarsal ligament beneath it, and passing the scalpel backwards for a short distance in the centre of the three outer intermetatarsal spaces the interossei muscles will be defined. On the removal of some areolar tissue from the hinder part of the sole, the insertion of the tibialis posticus, the tendon of the peroneus longus, some ligaments of the foot, and small deep anastomotic vessels come into sight.

MUSCLES OF THE FOURTH LAYER.

In the last layer of the sole of the foot are included the [illegible] and the tendons of insertion of the tibialis posticus [illegible] peroneus longus. When the same letters are used in the Figure they point to the same parts.

A	Prolongations of the tendon	X	Three plantar interossei.
V	of the tibialis posticus at	Z	Four dorsal interossei.
Y	its insertion.		

The *interossei muscles* are seven in number, and fill the interval between the metatarsal bones. Two are lodged in each metatarsal space, except the inner which has only one; and they are attached to the bones bounding laterally the spaces: they are arranged into a plantar and a dorsal set.

The *plantar set*, X, three in number, are slender fleshy slips which lie in the three outer spaces. Each arises from a single metatarsal bone, viz. fifth, fourth, and third. Opposite the metatarso-phalangeal joint each becomes tendinous, and is inserted into the inner side of the base of the first phalanx of its toe, fifth, fourth, and third, and gives a slip to join the extensor tendons on the dorsum of the phalanx.

The *dorsal set*, Z, are four in number, one being placed in each of the intermetatarsal spaces. Each has a double origin laterally from the two metatarsal bones between which it is lodged. Anteriorly they end in tendons which are inserted, like the plantar muscles, into the fibular side of the fourth and third toes and into both sides of the second toe: they join also the extensor tendons on the dorsum.

All the muscles are visible in the sole of the foot, where they are covered by fascia, by the external plantar nerve, and the plantar arch and its branches: near the toes the transversalis pedis and the transverse metatarsal ligament lie on them. On the dorsum of the foot only the dorsal set appear: and they are pierced behind by arteries passing from the one aspect of the foot to the other.

The chief office of these muscles is to approximate the four outer toes towards, or to remove them from the great toe; and they act therefore as abductors and adductors of those digits to the inner one. For instance the three plantar and the innermost dorsal muscle adduct the four smaller to the larger toe; and the remaining three muscles of the dorsal set will move the second, third, and fourth, toes away from that digit, so as to become abductors.

When the four outer toes are being bent by the action of the flexors the interossei will help in the completion of the process; and when the digits have been extended these muscles will serve to fix the first phalanges against the metatarsal bones.

Tendon of the peroneus longus, Q. The fleshy belly of the muscle in the leg is delineated in the following Plate; and only part of the course of its tendon, and the insertion, appear in this Figure. As now seen, the tendon winds round the outer surface of the os calcis to cross the foot from the outer to the inner side. At first it is received into a groove in the cuboid bone, and is then continued forwards to be inserted into the base of the metatarsal bone of the great toe, and into the fore part of the internal cuneiform bone; sometimes also by a slip into the base of the second metatarsal bone.

As the tendon crosses the sole it is contained in a sheath which is formed towards the outer part by the long plantar ligament, U, and the cuboid bone, and at the inner part by areolar tissue; and its motion in the sheath is facilitated by a synovial sac which extends to the insertion. On the outer aspect of the cuboid bone the tendon becomes flattened and thickened, and at that spot it contains either fibro-cartilage or a sesamoid bone.

Insertion of the tibialis posticus, T. Arising at the back of the leg (Plate LV.) its tendon passes along the inner side of the foot, supporting the articulation between the astragalus and scaphoid bone, and is inserted into the tubercle on the inner and under part of the os scaphoides. From the insertion processes are continued to several of the tarsal and metatarsal bones:—one, V, reaches the internal cuneiform; another, Y, is attached to the middle cuneiform and the second metatarsal; a third, W, is pro-

MUSCLES OF THE FOURTH LAYER.

In the last layer of the sole of the foot are included the interossei, and the tendons of insertion of the tibialis posticus and peroneus longus. When the same letters are used in the Figures they point to the same parts.

M, V, W, Y } Prolongations of the tendon of the tibialis posticus at its insertion.

X. Three plantar interossei.
Z. Four dorsal interossei.

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longed to the external cuneiform, the cuboid and the third and fourth metatarsal bones; and a fourth, M, is reflected backwards to be fixed into the os calcis. In short, the tendon is attached to all the tarsal bones except the astragalus, and to the metatarsal bones with the exception of those of the great and the little toe.

DEEP VESSELS OF THE SOLE.

Both tibial vessels end in the sole of the foot—the anterior passing through the first interosseous space, and the posterior entering at the inner side of the heel; and both furnish digital arteries to the toes.

c. External plantar trunk.
d. Digital branch of outside of little toe.
e. Digital branch of inside of great toe.
f. Digital branch of first and second toes.
g. Digital branch of second and third toes.
h. Digital branch of third and fourth toes.
i. Digital branch of fourth and fifth toes.
l. Dorsal artery of the foot.
n. Artery of the great toe.
o. Communicating branch to deep arch.

The *plantar arch* is the curved terminal part of the external plantar artery, *c*. Its extent is limited by the base of the little toe in one direction, and the back of the first interosseous space in the other. Internally it joins the dorsal artery of the foot (anterior tibial) by means of the communicating branch, *o*, so as to establish a direct inosculation between the main vessels on the fore and hinder aspects of the leg. In this course it crosses three of the metatarsal bones near their tarsal ends, and rests on most of the interossei muscles. At the outer part it is covered by the flexor perforans and the lumbricales, and at the inner, by the adductor pollicis.

Companion veins lie on its sides, and the external plantar nerve curves in a similar way just behind it.

From the convexity or anterior part of the arch proceed digital arteries, and from the concavity arise perforating and small nutritive branches.

The *digital branches*, four in number, are distributed to the three outer toes and half the second. Each, except the most external, splits at the cleft of the toes to supply the contiguous sides of two; and at the point of division springs a small branch (*anterior perforating*), which passes downwards to anastomose with the interosseous arteries on the dorsum of the foot. As they lie on the interossei small offsets are emitted to those muscles.

The first branch, *d*, lying on the outside of the small toe, remains single to the end of the digit, and furnishes cutaneous branches to the outer part of the foot, like the nerve.

The second, *i*, placed over the fourth interosseous space may communicate with the former by a cross piece (Plate LVI.); it gives an offset to the fourth lumbricalis, and branches for the sides of the fifth and fourth digits.

The third corresponds with the third space, and furnishes offsets to the third lumbricalis and the transversalis pedis: its two terminal pieces belong to the sides of the fourth and third toes.

The fourth may supply the second lumbricalis; and it ends on the sides of the third and second digits.

On the toes the arteries are continued to the extremity, one on each side; and they unite in an arch on the plantar surface of the last phalanx, from which fine branches are sent to the tip of the digit. At the extremity of the second toe the branch derived from the plantar arch anastomoses with the digital branch, *f*, of the dorsal artery of the foot. Whilst the arteries lie on the sides of the digits they furnish superficial offsets forwards and backwards, and communicate beneath the flexor tendons by means of cross branches behind the interphalangeal articulations, as in the fingers.

Three *posterior perforating branches*, *s*, pass down from the arch between the lateral attachments of the dorsal interossei muscles of the outer three spaces, and anastomose with the interosseous arteries on the dorsum of the foot.

Some small *nutritive* and *muscular* branches take their origin from the arch, and from the digital arteries.

The external plantar artery of the foot answers to the ulnar artery of the hand; it resembles that vessel in furnishing digital branches to three toes and a half, and in forming an arch which communicates internally with the other leading vessel of the limb.

But the following marked differences exist in the mode of ending of the two main bloodvessels of the limbs. In the foot there is but one arch in which both tibials are united; and the plantar arch thus formed has a deep position in the sole of the foot, where it lies in contact with the interossei. In the hand on the contrary there are two distinct palmar arches—superficial and deep, which communicate through the intervention of small branches: of these, the former is continuous with the ulnar artery, and the latter with the radial.

On comparing also the muscular offsets of the arterial trunks in the hand and foot considerable dissimilarity will be found, as in the nerves, on account of the want of uniformity in the muscles of the two parts.

Wounds of the plantar arch can take place but seldom in consequence of the vessel being protected by the shoe and the depth of the soft parts. If it was opened it would bleed freely, as in injury of the palmar arch, from its free inosculation with the anterior tibial artery.

With bleeding from a wound in the foot, such as would lead to the supposition that the arch itself, or one or more of the digital arteries close to their origin from it had been opened, the flow of blood would generally be arrested by pressure applied to the anterior tibial artery on the dorsum of the tarsus, to the posterior tibial between the heel and ankle, and to the wound in the foot by a graduated compress, as in the case of wounds of the palm of the hand. Should considerable recurrent bleeding continue under this treatment, ligature of one or both of the tibials may be resorted to to cut off the free supply of blood to the foot.

Dorsal artery of the foot, l. This artery is a continuation of the anterior tibial trunk (Plate LVIII.), and furnishes digital branches to one toe and a half. It enters the sole at the back of the first interosseous space, and ends by joining the plantar arch

through the *communicating* part, *o*. From its extremity in the sole of the foot the large artery of the great toe is sent forwards, and one or two small branches run backwards.

The *large artery of the toe*, *n*, (art. mag. pol.) is the digital branch of the anterior tibial, and supplies one toe and a half: it has the following arrangement. It runs forwards over the first interosseous muscle to the cleft of the toes, where it splits into the two collateral branches for the great toe and the next; and near the fore part of the interosseous space a branch is directed inwards under the flexor muscles, or between the heads of the short flexor, to form the digital branch, *e*, of the inner side of the great toe.

The anterior tibial artery in the foot resembles the radial artery in the hand in supplying branches to one digit and a half. But it differs from that vessel chiefly in assisting to complete the plantar arch instead of forming, like the radial, a separate arch.

Deep anastomosis of the foot. In the sole of the foot amongst the processes of the tendons and the ligaments is situate an anastomotic chain between branches of the internal and external plantar with the dorsal artery of the foot, as is set forth in the Drawing.

External plantar nerve, 3. In this dissection of the nerve the branches to the interossei are traced out. From the part of the nerve by the side of the plantar arch small muscular offsets are supplied to all the interossei muscles: these are so evident as not to require figures to point them out. The remaining muscular branches of this part of the nerve have been described with Fig. i.

DESCRIPTION OF PLATE LVIII.

The dissection of the front of the leg and dorsum of the foot appears in this Illustration.

In preparing the dissection divide the skin along the centre of the limb, and reflect it to the sides by means of a cross cut at each end, and a third opposite the ankle. After search has been made for the cutaneous nerves and vessels in the fat, the fascia may be taken away to show the muscles and the deeper vessels and nerves; but in executing this step the two parts of the anterior annular ligament are to be defined and left, as in the Plate.

CUTANEOUS VEINS AND ARTERIES.

On the dorsum of the foot is the arch in which the saphenous veins begin. The small arteries ramifying on the surface of the leg and foot are derived from the anterior tibial trunk.

a. Venous arch of the foot.
b. Internal saphenous.
c. External saphenous.
d. Communicating veins.
p. Venæ comites.

The *venous arch*, *a*, on the dorsum of the foot, answers to a similar arch on the back of the hand. Contained in the subcutaneous fat, it is placed anterior to the tarsus. Its convexity is turned towards the toes, and is joined by small digital veins; and at its concavity open small superficial, with some deep veins, *d*. At each end the arch blends with a saphenous vein.

The *internal saphenous vein*, *b*, begins at the inner end of the dorsal arch, and ascending to the leg in front of the inner ankle crosses obliquely the tibia: its further course in the leg behind that bone is manifest in Plate LIII.

The *external saphenous vein*, *c*, springs from the confluence of

the outer end of the arch with a vein from the outer side of the foot: it soon bends below the outer ankle to the back of the leg, where it is represented in Plate LIII.

Cutaneous arteries. In the leg these are small in size, and are offsets of the anterior tibial, but as they are unnamed no letters of reference have been placed on them. They issue mostly along the borders of the tibialis anticus, and those along the outer side of the muscle mark the position of the subjacent tibial trunk. One larger than the rest, and external to them, pierces the fascia outside the extensor of the toes, B, and runs with the musculo-cutaneous nerve, 3.

On the dorsum of the foot and toes the other small unnamed arteries originate in the dorsal artery of the foot and its branches.

CUTANEOUS NERVES OF THE FRONT OF THE LEG.

On the dorsum of the foot, as on the back of the hand, there is a free distribution of cutaneous nerves; whilst the teguments on the fore part of the leg, like those on the back of the forearm are but sparingly supplied with nerves.

1. Internal saphenous.
2. External saphenous.
3. Musculo-cutaneous.
4. Cutaneous of external popliteal.
5. Cutaneous of anterior tibial.

The *internal saphenous*, 1, courses along the inner side of the leg (Plate LIII), and sends forwards many fine branches to the teguments over the tibialis anticus: the largest of these, near the knee, is marked thus, †. Below the middle of the leg it turns to the fore part of the ankle with the saphenous vein to end in the teguments of the inner side of the instep, reaching about two thirds along the foot. Near the ending it is joined by the musculo-cutaneous; and some of the terminal filaments sink through the fascia, like the musculo-cutaneous nerve in the forearm, to supply the tarsus.

The *external saphenous*, 2, a branch of the internal popliteal trunk (p. 412), descends along the back of the leg to the heel (Plate LIII). Bending forwards below the external malleolus, it

runs along the outer border of the foot, and terminates on the outside of the little toe. When in contact with the foot it furnishes nerves to all the outer margin, but the offsets to the sole are larger than those on the dorsum. Oftentimes the nerve is large ; supplying then more digits than usual, and more of the dorsum of the foot.

The *musculo-cutaneous nerve*, 3, is one of the terminal pieces of the external popliteal trunk (p. 423), and takes partly a deep and partly a superficial position in the limb, so as to give branches to muscles and integuments—whence the name. Beginning at the back of the limb, it is directed forwards at first outside the fibula and under the peroneus longus. In front of that bone it is inclined down between the peronei muscles and the extensor longus digitorum ; and gradually reaching the surface, it pierces the fascia in the lower third of the leg to end on the dorsum of the foot and toes.

When the nerve is beneath the fascia it furnishes offsets to the peroneus longus and brevis muscles.

After it becomes cutaneous it divides into two pieces, inner and outer, which are continued over the dorsum of the foot to the extremities of the toes, like the radial nerve on the hand. These two branches may vary much in size and in distribution ; but commonly they supply dorsal digital nerves to all the toes, except the outer side of the little toe, and the contiguous sides of the great and second toes. Each of the two primary pieces furnishes offsets to its side of the foot, and communicates with the saphenous nerve close to it.

Anterior tibial nerve, 8. At the back of the first interosseous space this nerve becomes cutaneous ; and it ends in two dorsal digital nerves for the adjacent sides of the first and second toes. Offsets of it enter the teguments of the first interosseous space ; and it is joined by the musculo-cutaneous nerve.

Cutaneous of the external popliteal, 4. Arising from the external popliteal at the back of the limb, and piercing the fascia, it is distributed in the integuments of the fore and outer part of the leg as low as the spot at which the musculo-cutaneous makes its appearance.

MUSCLES OF THE FRONT OF THE LEG.

Two groups of muscles come into view in this Illustration: an anterior which bends the ankle and extends the toes; and a lateral for the extension of the ankle.

A. Tibialis anticus.
B. Extensor longus digitorum.
C. Extensor longus pollicis.
D. Peroneus tertius.
F. Extensor brevis digitorum.
H. Peroneus longus.
I. Peroneus brevis.
J. Upper part of annular ligament.
K. Lower part of annular ligament.
N. External annular ligament.
O. Fibro-cartil. sheaths for peronei.

Anterior group of muscles. Between the tibia and fibula are lodged two flexors of the ankle (tibialis and peroneus tertius); and between them are situate the long extensor of the toes and the special extensor of the great toe. On the dorsum of the foot lies the short extensor of the toes.

The *tibialis anticus*, A, is the widest and most internal muscle of the group. Its origin is fixed to the upper half or rather more of the outer surface of the tibia, and to the contiguous part of the interosseous membrane — the membranous attachment reaching rather lower down than the osseous. In the lower third of the leg the muscle acquires a tendon, and passing through a sheath in each part of the annular ligament, is inserted into the inner surface of the internal cuneiform bone, and the base of the metatarsal bone of the great toe.

In contact with the fascia throughout, the muscle is inseparably united with it by an aponeurosis at the upper part. It rests on the tibia and the interosseous membrane, covering the spine of that bone in the lower third of the leg; and lies over the ankle joint and the tarsus. Its outer border touches the extensor digitorum and extensor pollicis, and is the guide to the anterior tibial vessels. In the annular ligament the tendon is surrounded by a synovial sac which reaches nearly to the insertion.

With the foot free to be moved the muscle will bend the ankle and carry inwards the great toe; it can also raise the inner border of the foot, rotating inwards this part. The foot being fixed, as

in standing, it will help the tibialis posticus to lift the inner margin of the instep, so as to make the outside of the foot the supporting part of the body.

After the advanced foot has reached the ground in walking, the muscle will be able to bring the tibia forwards over the foot; and in stooping and rising it will assist in steadying the bones of the leg.

In deformity of the foot with inversion, and elevation of the inner part of the sole from the ground, the tendon of the tibialis is shortened and prominent, and will have to be divided with others before the sole can be brought into its natural position in the treatment of that ailment.

The *peroneus tertius*, D, is small, and is generally united with the extensor longus digitorum. It arises from the lower fourth or third of the inner surface (anterior part) of the fibula, below the long extensor of the toes, and from the lower end of the interosseous membrane. The tendon varies much in size, like the fleshy part of the muscle, and is transmitted through a sheath in the lower part of the annular ligament with the long extensor, to be inserted by a widened extremity into the upper part of the base of the fifth metatarsal bone.

More or less joined with the long extensor of the toes, it is superficial throughout, and is separated from the peroneus brevis behind it by a piece of fascia which is fixed into the fibula. Underneath the muscle lie the lower portion of the fibula, the ankle-joint, and the short extensor of the toes.

When the foot hangs the muscle will be employed as a flexor of the ankle, like the tibialis; and it will raise the outer border of the foot. But should the limb be fixed by contact with the ground the action of the peroneus tertius on the leg in walking and stooping will be the same as that of the tibialis.

The *extensor longus digitorum*, B, is a thin narrow muscle, which arises from the head and three fourths of the inner surface (anterior part) of the fibula; from the external tuberosity of the tibia, and the contiguous interosseous membrane (about an inch); and from the fascia of the leg. Its tendon below is contained in a sheath in the lower portion of the annular ligament with the

peroneus tertius, and divides into four pieces of attachment for the four outer toes.

On the back of the toes the tendons are arranged like those of the extensor of the fingers. For example, on the first phalanx there is a fibrous expansion, which is not fixed into the subjacent bone, and is formed by pieces of the long and short extensors, and by tendons from the lumbricalis and interossei; but that on the little toe does not receive any contribution from the short extensor. At the front of the metatarsal phalanx the expansion divides into three parts, which are connected with the two remaining phalanges in this manner:—The short central piece is inserted into the base of the middle phalanx; and the two lateral blend into one at the fore part of that bone, and are inserted into the base of the last phalanx. Opposite the two nearest phalangeal joints a fibrous slip descends on each side from the expansion to blend with the capsule of those articulations.

The muscle lies partly in the leg and partly on the dorsum of the foot; and although not fixed into the nearest phalanx, it is so closely united to that bone by the other tendinous slips joining it, as to be able to extend the metatarso-phalangeal joint. Like the tibialis it is superficial throughout. Along the inner side lie the tibialis and extensor pollicis with the tibial vessels and nerve; and on the outer are situate the two external peronei, but separated by a process of fascia.

If the foot and toes are not fixed the muscle extends the phalangeal joints from root to tip, separating the digits at the same time; and it raises afterwards the foot so as to bend the ankle.

Should the foot rest on the ground with the fibula slanting backwards that bone can be brought forwards by the muscle over the foot. In stooping and rising it will assist the tibialis.

The *extensor brevis digitorum*, F, occupies the dorsum of the foot, and gives tendons to the four inner toes. Thin and fleshy behind, it arises from the outer surface of the os calcis near the fore part, and from the outer end of the lower piece of the anterior annular ligament. At the back of the metatarsal bones it divides into four fleshy bundles; and from these proceed tendons to join the common expansion on the dorsum of the first phalanx in the

case of the three outer, but the tendon of the great toe is inserted separately into the base of the nearest phalanx.

On the instep the muscle is covered by the long extensor and the peroneus tertius; and the inner fleshy belly, larger than the others, is detached from the rest of the muscle for a greater distance. The tendons blend with those of the long extensor, and are applied to the outer border.

It assists the long extensor in straightening the toes, and directs them somewhat out at the same time.

The *extensor proprius pollicis*, C, is concealed for the most part by the preceding muscle. It takes origin from the middle three fifths of the inner surface (anterior part) of the fibula, and from the interosseous membrane. At the ankle it ends in a tendon, which is contained in a space in the lower piece of the annular ligament, and is thence directed over the inner part of the foot to be inserted into the base of the last phalanx of the great toe.

The part of the muscle in the leg is deeply placed between the extensor longus digitorum and the tibialis; but the tendon on the dorsum of the foot is superficial. The tibial vessels lie inside the extensor as low as the ankle, but afterwards outside it.

As this muscle passes over the ankle, like the extensor of the digits, it has a similar action, viz. first straightening its digit and next bending the ankle. And the slanting limb touching the ground, the extensor of the great toe will help to move the fibula over the foot; or to support that bone in stooping.

The *anterior annular ligament* of the leg is constructed by the deep fascia strengthened by transverse fibres near the ankle-joint. It incases and binds down the tendons of the muscles, and consists of two parts—upper and lower.

The upper piece, J, is placed above the ankle, and is squarer in form than the lower. It is attached laterally to the tibia and fibula, and is continued into the fascia of the leg by the upper and lower edges. In it is one sheath towards the inner side for the tibialis anticus, and this is lined by a synovial sac, which is prolonged on the tendon into the other part of the ligament; whilst the other muscles of the leg pass under it without being contained in sheaths. This band serves the purpose of fixing the

vertical parts of the long muscles to the front of the ankle, and rendering them able to bend that joint.

The lower piece, K, is wide and thin internally but pointed and thick externally, and lies below the level of the ankle on the outer side. Externally it is fixed into the upper surface of the os calcis close to the interosseous ligament, and internally into the tibial malleolus and the plantar fascia; and it blends with the deep fascia by its edges. Three sheaths for tendons are constructed in it; an inner for the tibialis anticus, an outer for the extensor longus digitorum and peroneus tertius, and an intermediate for the extensor proprius pollicis. A synovial sac lubricates each sheath, and the inner one is continued into the compartment in the upper piece, J, of the ligament. The use of this part is to bind horizontally the tendons of the long extensors to the foot, so that they may be able to act on the ankle as well as the digits.

LATERAL MUSCLES OF THE LEG.—Two muscles enter into this group; and as they are attached to the fibula they are named peronei.

The *peroneus longus*, H, the highest and most superficial of the two, arises from the outer or anterior surface of the upper half of the fibula, though gradually diminishing in width downwards; from the external border of that bone by thin fleshy fibres, behind the peroneus brevis, as low as the inferior fifth; and from the fascia incasing the muscle. Its long tendon passes through an annular ligament behind the outer malleolus, and through a separate sheath of fibro-cartilage, O, on the outer side of the os calcis to reach its insertion in the sole of the foot (p. 451).

Superficial in the leg it rests on the fibula and the peroneus brevis, concealing altogether this muscle above, but only in part below. By means of the sheaths attaching it to the bones the peroneus can move both the ankle joint and the foot. In the sole of the foot it lies deeply, and is received into a third fibrous sheath (Plate LVII. Fig. 2. Q).

The muscle is able, when the foot is unsupported, to extend the ankle, and to raise the outer border of the instep, depressing at the same time the great toe and the inner edge.

The foot being immoveable the peroneus longus will elevate the

outer border, throwing the weight of the body on the inner side; and in rising from stooping it will help to bring back the fibula to a right angle with the foot.

The *peroneus brevis*, I, is attached to the outer or anterior surface of the fibula for the lower two thirds of the shaft—the upper end being pointed and lying inside its fellow; and from the intermuscular septum between it and the anterior muscles of the leg. At the ankle its tendon passes with that of the peroneus longus through the external annular ligament, lying next the bone; escaped from this it is received into a sheath, O, on the outer side of the os calcis, above that for the peroneus longus; and it is finally inserted by a widened end into the base of the metatarsal bone of the little toe.

In the leg the lower part of this peroneus is superficial in front of the other, and its tendon is connected to the fibula and the tarsus by sheaths like those of its companion. Fascia isolates it from the muscles on the front and back of the leg.

This muscle extends the ankle, and moves the foot outwards almost horizontally when the toes are not supported; but when the foot is fixed, as in standing, it will assist the long peroneus in raising the outer border from the ground. In rising from stooping it acts on the fibula like the peroneus longus.

External annular ligament, N. This is a thin band behind and rather below the fibular malleolus, which is formed by thickened fascia, like the other annular ligaments near the ankle. In front it is attached to the malleolus, and behind to the os calcis. Its upper end joins the fascia of the leg, and the lower is united by a thin fibrous layer to the bands of fibro-cartilage fixing the tendons of the peronei to the os calcis. There is but one space in the ligament, and this lodges the two peronei; it is lubricated by a synovial sac, which bifurcates inferiorly into two—a piece being continued with each tendon into the fibro-cartilaginous sheath.

ANTERIOR TIBIAL VESSELS.

The anterior tibial artery with its venæ comites extends through the front of the leg to the sole of the foot.

e. Cutaneous branch with a nerve.
f. Offsets of the recurrent branch.
g. Anterior tibial trunk.
h. Dorsal artery of the foot.
i. Internal malleolar branch.
j. Anterior peroneal branch.
k. Tarsal branch.
l. First dorsal interosseous.
n. Metatarsal branch.
o. Three outer interosseous.

The anterior tibial artery, *g*, is derived from the splitting of the popliteal trunk at the lower edge of the muscle of the same name ; and it reaches to the hinder part of the first interosseous space, where it enters the sole, ending as before said (p. 454). Beginning at the back of the leg (Plate LV.) it is directed forwards at first between the bones and above the interosseous membrane, and then along the front of the leg and dorsum of the foot. A line on the surface from the inner part of the neck of the fibula to the first interosseous space would mark the position of the subjacent vessel. For the purposes of description a division of it into two is commonly made, viz. an upper part called anterior tibial, and a lower, which has been named the dorsal artery of the foot.

In the leg the anterior tibial is deeply placed between the fleshy bellies of the muscles ; but it becomes more superficial near the ankle, and is covered finally only by the annular ligament and the teguments. To its inner side nearly all the way is the tibialis anticus ; though close to the ending the extensor proprius pollicis intervenes between the two, having crossed the artery just above the ankle. On the outer side comes first the extensor longus digitorum for about two inches, then the extensor pollicis as far as the ankle, and finally the extensor longus digitorum again at the ending. It rests in the upper two-thirds of its course on the interosseous membrane, and in the lower third, on the tibia and the ankle-joint.

Companion veins, *p*, encircle the artery, forming a plexiform disposition over the upper part. The anterior tibial nerve, 6, comes into contact with the vessels about the place of meeting of the upper and middle thirds of the leg, and runs with them to the foot ; at first it is external, then internal to the vessel, and finally external in position on the dorsum of the foot.

Branches. Most of the collateral offsets are unnamed, and are

distributed to the neighbouring muscles and the teguments. Even the named branches are small in size, like the offsets of the arteries of the upper limb ; they are the following :—

The *recurrent branch* springs from the upper end of the artery, and ascends through the tibialis to the knee-joint : it gives branches to that muscle, and its superficial ramifications are marked with *f*.

A *cutaneous branch*, *e*, accompanies the musculo-cutaneous nerve : it supplies the contiguous muscles, and ends in the teguments.

Malleolar branches. Two small arteries with this name take origin a little above the ankle, and ramify over the malleoli : the inner is shown by, *i* ; and the outer, concealed by the muscles, joins the anterior communicating branch, *j*, of the peroneal artery (p. 432).

Articular branches pass from the lower end of the artery into the ankle-joint.

Peculiarities. Occasionally the trunk of the anterior tibial artery has been found superficial to the muscles in the lower part of the leg ; in such a condition of the vessel a superficial wound might lay it open. Its size is very variable, like the arteries of the upper limb, and the deficient part is supplied by an offset from the posterior tibial, or the peroneal artery.

Dorsal artery of the foot, *h*. This part of the anterior tibial extends from the ankle-joint to the ending in the sole. It lies near the surface ; and its position will be found by the line before mentioned.

For the greater part of its extent it is covered by the inner piece of the extensor brevis digitorum, but at the beginning and ending only by the special fascia and the teguments. It is firmly supported by the subjacent tarsal bones. Laterally it has a tendon on each side, viz. the extensor pollicis internally, and the extensor longus digitorum externally, but both are at a distance from it—about half an inch.

The venæ comites have the same arrangement here as above, and the anterior tibial nerve is placed on the outer side.

Branches. Many offsets are given to the tarsal and metatarsal portions of the foot : those leaving the inner side of the vessel

are unnamed; and those on the outer side, which are rather larger, are named tarsal, metatarsal, and interosseous, from their distribution.

The *tarsal branch*, *k*, arises opposite the scaphoid bone, and is directed beneath the extensor brevis digitorum to the outer part of the tarsus; it gives branches to that muscle, and anastomoses with the arteries before and behind it, viz. metatarsal, *n*, and anterior communicating of the peroneal, *j*.

The *metatarsal branch*, *n*, leaves the trunk at the fore part of the tarsus, and runs outwards across the base of the metatarsal bones to the border of the foot, where it anastomoses with the tarsal and external plantar arteries. In its course it lies beneath the short extensor, and forms an arch, from the fore part of which the following small interosseous arteries proceed:—

The *dorsal interossei*, *o*, of the three outer spaces spring from the metatarsal branch, and run forwards to the cleft of the toes. Here each bifurcates, and the small resulting branches are continued to the end of the toes as the dorsal digital arteries: the most external furnishes also a branch to the outer side of the little toe. From the beginning of each interosseous branch a piece descends to the sole of the foot to unite with the plantar arch; and from the ending springs another offset to enter a digital artery: these are named anterior and posterior perforating branches (p. 453).

First dorsal interosseous branch, *l*, arises from the dorsal artery as this is about to sink into the foot: it is continued forwards in the first space, in the same manner as the other arteries, and divides like them for the sides of the first two toes. The space receives offsets from it.

Branch of the peroneal artery, *j*. The anterior communicating branch of this artery (p. 432) comes through the aperture in the lower part of the interosseous membrane, and descends in front of the outer malleolus to the tarsus, where it distributes many branches: above it anastomoses with the external malleolar, and below with the tarsal artery.

Venæ comites. The anterior tibial veins have the same extent and connections as the artery, and end above in the popliteal

trunk : in their course they receive branches corresponding with those of the artery. They have a plexiform disposition around the tibial bloodvessel, especially above; and they anastomose with the internal saphenous vein.

Peculiarities. The dorsal artery of the foot is subject to great variations in its position and size. Frequently it forms an arch under the extensor brevis digitorum, with the convexity towards the outer border of the foot. Much bleeding from a wound on the top of the foot towards the outer part, which would be far out of the usual line of the vessel, would suggest the possibility of the artery being opened in its unusual situation.

When the anterior tibial is so small as not to reach to the lower part of the leg the anterior communicating branch of the peroneal becomes the dorsal artery of the foot, and takes the place of the deficient tibial trunk : this substituted vessel may have also the same uncommon curved course on the dorsum of the foot as the anterior tibial.

Ligature. In the dead body the artery is easily reached in consequence of its superficial and fixed position; and the operation of ligature may be practised on it in the following way:—

First, the position of the vessel is to be ascertained by a line on the surface, from the centre of the ankle to the back of the first interosseous space.

A cut in that line, about two inches in length and nearer the interosseous space than the ankle-joint, is to divide the skin, the teguments, and the deep fascia covering the muscles.

After cutting through the superficial strata the inner piece of the extensor brevis digitorum comes into sight; and the tendon connected with those fleshy fibres serves as the deep guide to the bloodvessels issuing from beneath. In the botton of the wound appears the anterior tibial nerve, which is generally outside and close to the artery; but the tendons of the long extensors of the digits are at some distance from the vessel, and are not visible.

Opening now the arterial sheath, and detaching the venæ comites, the thread is to be passed around, and to be knotted on the vessel in the usual way.

Should the tibial artery have the unusual course on the dorsum

of the foot, which has been before cited (p. 468), no bloodvessels will be met with by an incision in the usual line of the artery; but if the cut be made to reach the interosseous space the wandering vessel may be recognised coming to the hinder part of that interval to enter the foot.

Wound of the artery. Considerable bleeding would follow the opening of the artery on the dorsum of the foot on account of the free communication of the anterior with the posterior tibial bloodvessel. For the arrest of the hæmorrhage two plans may be adopted. According to the one two ligatures may be applied to the vessel, one above, and the other below the opening; and according to the other pressure may be made on the trunk of the artery, and to the wound, whilst, if necessary, the flow of blood in the posterior tibial artery may be checked by the employment of a compress to that trunk.

Lymphatics of the leg. Only a summary of these small vessels will here be given, as they are not indicated in the Figure. There are superficial and deep lymphatics with the blood vessels, as in the upper limb.

In the superficial set are two groups, one with each saphenous vein. The lymphatics with the short saphenous enter the popliteal glands; and those with the long saphenous vein open into the inguinal glands. Enlargement and inflammation consequent on disease or irritation of the lymphatics on the opposite borders of the foot would affect different glands.

The deep lymphatics run along the main arteries, and all converge to the popliteal glands. In connection with the lymphatics on the anterior tibial artery is situate a small gland; this is the lowest in the limb, and is to be found about half way down the leg.

BRANCHES OF EXTERNAL POPLITEAL NERVE.

The three terminal branches of the external popliteal nerve, viz. recurrent tibial, anterior tibial, and musculo-cutaneous, which begin between the fibula and the peroneus longus, are met with in the dissection of the front of the leg.

5. Recurrent tibial branch.
6. Anterior tibial nerve.
7. Branch to short extensor of the toes and the tarsus.
8. Cutaneous part of anterior tibial.

The *recurrent tibial branch*, 5, passes under the extensor longus digitorum, but over the tibial vessels, to the artery of the same name, and ascends through the tibialis anticus to the knee-joint.

The *anterior tibial nerve*, 6, is directed, like the preceding, beneath the long extensor of the toes, and meets with the tibial vessels above the middle of the leg. From this point it is closely applied to those vessels, crossing them once or more; and continues on the outer side of the dorsal artery of the foot till this bloodvessel enters the sole. Finally it pierces the fascia, and ends in the integuments of the great toe and the next.

This nerve furnishes offsets to all the muscles of the front of the limb below the knee. It supplies, namely, the two flexors of the ankle (tibialis anticus and peroneus tertius); the common extensors of the toes (ext. digit. longus and brevis); and the special extensor of the great toe (ext. prop. pollicis). To the tarsus it gives a large branch, 7, which resembles much in its appearance the nerve distributed to the back of the wrist: from this branch offsets are sent to the extensor brevis digitorum, which covers it, as well as to the underlying bones and articulations.

The *musculo-cutaneous nerve*, 3, takes a downward course at first between the fibula and the peroneus longus, H, and nextly, between the peroneus brevis and the extensor longus digitorum, B, to become cutaneous at the lower third of the leg. Its ending on the dorsum of the foot and the toes has been before described (p. 458).

Before the nerve pierces the deep fascia it emits branches as before said to the two lateral peroneal muscles.

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